Advant® OCS
with Master software

S600 I/O Hardware
Advant® Controller 160

Reference Manual

3BDS 005 558R101

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WARNING	Hazards which could result in personal injury
CAUTION	Hazards which could result in equipment or property damage
NOTE	Alerts user to pertinent facts and conditions

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Chapter 1 Introduction

1.1 Before You Begin

Advant OCS is a system for industrial automation. It consists of a family of computer-based units and a local area network for communication.

A controller is a computer-based unit in which control applications are running. A controller is connected to the process via the process I/O hardware.

The process I/O hardware for Advant Controller 100 Series is the S600 I/O. Hardware modules common for both Advant Controller 110 and Advant Controller 160 are described in the *S600 I/O Hardware Reference Manual/Revision B.*

This manual describes the S600 I/O, which is only available for Advant Controller 160. Within the manual, all components of the S600 I/O are listed in alphabetical order. For each I/O module, you will find technical data, examples of how to connect it to the process, and a description of its functions.

1.2 How To Use This Book

Basic Structure

This book is organized into chapters and sections as shown in Figure 1-1.

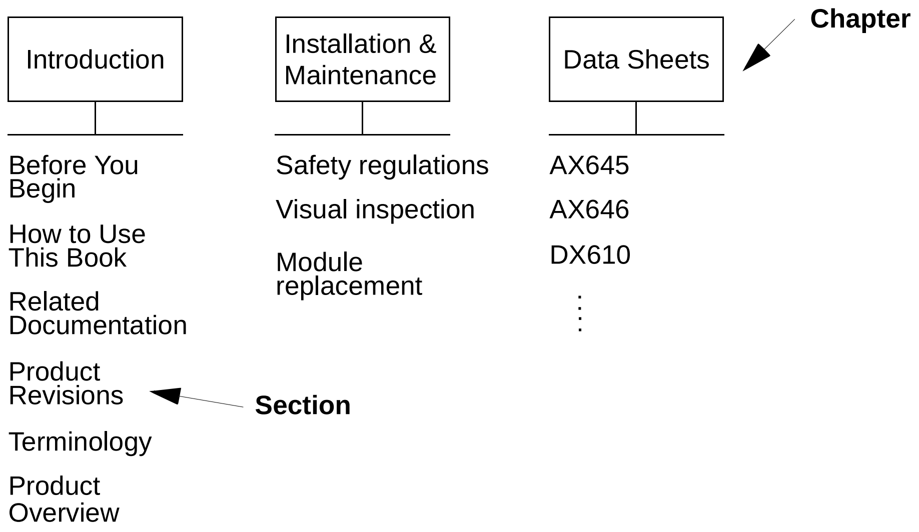


Figure 1-1. Manual Organization Structure

Introduction

Chapter 1 (this chapter) provides introductory and background information, including:

- Guidelines on how you can find information in this manual.
- This manual’s relationship to other Advant Controller 100 Series documents.
- A glossary defining terms frequently used in this manual.
- A product and functional overview. Read this to get an idea of which components belong to the S600 I/O and what they do.

Installation and Maintenance

In chapter 2 you will find general regulations and guidelines about installation and maintenance of the S600 I/O including:

- Safety regulations
- Guidelines for visual inspection
- Guidelines for module replacement.

Data sheets

In chapter 3 you will find data sheets of all components of the S600 I/O. They are listed in alphabetical order.

In general, a data sheet contains the following informations:

- Summary
- Associated data base elements
- Technical data
- Front view
- Process connections
- Functional description.

1.3 Product Revisions

The product revision (release designation) of a S600 I/O module can be seen using the Advant Station 100 Series Engineering Station. The functions *Report Errors* and *Diagnose Module* both will show the type, variant and revision of a S600 I/O module as in Figure 1-2.

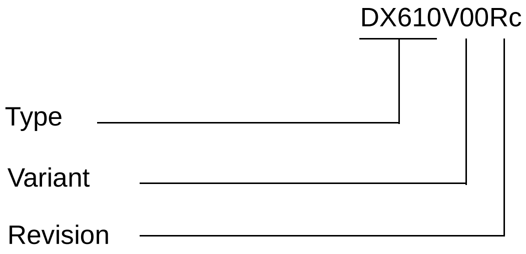


Figure 1-2. Example of Product Revision of a S600 I/O Module

The variant indicates the firmware or hardware function variants of the same module type (for example CI532V01 provides RCOM protocol function, CI532V02 provides MODBUS I protocol function).

The *Release Note* for a specific release of Advant Controller 160 includes a list, showing which product revision of a S600 I/O module matches with that Advant Controller 160 release. Consult this list, when you want to replace the Advant Controller 160 Base software by another one with a different release.

1.4 Terminology

The following is a list of terms associated with Advant Controller 160 that you should be familiar with.

Term	Description
AC 160	**A**dvant **C**ontroller **160**.
AF 100	**A**dvant **F**ieldbus **100**.
AMPL	The **A**BB **M**aster **P**rogramming **L**anguage, used for application programming.
Application Program	An application program is a general concept of an assembly of program functions aimed at realizing and automating an addressed process control function.
Application (user-built)	An application is a user-implemented configuration of standard hardware and software units. It is the solution to the user's problem.
AS 100ES	**A**dvant **S**tation **100** Series **E**ngineering **S**tation.

Term	Description
Backplane	A backplane is part of a subrack which interconnects inserted electronics *modules* with the help of a communication bus.
Basic Station	The station containing the Processor Module(s) is called Basic Station.
Basic Subrack	The subrack housing the Processor Module(s) is called Basic Subrack.
Basic System	Basic system is the abstract name of a minimal composition of functional units forming a system.
Basic Unit	Basic unit is used for ordering purposes (for example, in the Price Book) as a name for the smallest unit to be ordered or a platform for further enlargement with alternatives and options.
BIOB	Short for **B**ackplane **I**/**O** **b**us of Advant Controller 100 Series.
Cabinet	The cabinet is the outer case of a piece of equipment (a packaging option), for example, Controller cabinet, I/O cabinet.
CPU, Central **P**rocessing **U**nit	A CPU is a functional unit consisting primarily of a microprocessor and memory.
CI	**C**ommunication **I**nterface.
Circuit Breaker	In the context of a process control system, a circuit breaker is a device designed to open and close a circuit by nonautomatic means and to open the circuit automatically on a predetermined overload of current, without injury to itself.
Cold Start	Cold start resets hardware and software of a *controller* to their initial states. In case of Advant Controller 110, application software is loaded from the internal PROM to RAM of the CPU.
Controller	Controller is a descriptive name for Advant Controller products. A controller is an entity in which control applications are running. From the product viewpoint, a controller consists of *CPU*, communication and certain auxiliary equipment such as power supply. It also includes the functionality of process I/O (the process data communication software). It does not include process I/O hardware (and firmware as applicable). See also *Process station.*

Term	Description
Engineering Station	In the following chapters this term is used as an abbreviation for Advant Station 100 Series Engineering Station.
ESD	**ESD** stands for **E**lectro**S**tatic **D**ischarge.
I/O	I/O is process **I**nput or **O**utput. From the functional and geographical distribution viewpoint, process I/O is distinguished into two main categories: • central (located close to the controller) • distributed (in the process environment).
I/O Station	The station containing only I/O modules and no Processor Module is called I/O Station.
Initialization	Initialization sets a starting position.
LED	**L**ight **E**mitting **D**iode.
Local Control, local operator	Local control is a mode of operation where responsibility is assigned to an operator/equipment located in the process environment close to the process object.
Module	A module is a hardware unit, with or without accommodated software, or a software unit. There are modules of various sizes and functionality. Examples of hardware modules: *Subrack, submodule carrier*, communication module, I/O module. Examples of software modules: Basic system program module in a controller, a PC element.
Multi-drop Connection	A multi-drop connection is a means of establishing a multi-drop network, that is, a network with two endpoint *nodes*, any number of intermediate *nodes* and only a single path between any two *nodes*.
Node	A node in general: A point in a data network. A node in an application: 1. Any logically addressable unit directly connected to the plant or *control network*. Examples are controller, process station, operator station. 2. Any logically addressable unit connected via RCOM.
Off-line	With off-line configuration, configuration data is created outside the application for later installation, or the internal configuration data is directly affected, but the application is inactive.

Term	Description
On-line	With on-line configuration, the internal configuration data of a system application is directly affected, while the application is active.
Position	Position means: 1. The place in the subrack where you put a *module*. 2. The place in a *submodule carrier* where you put a submodule (submodule position).
Process Object	A process object is process concept/equipment, for example, valve, motor, conveyor, tank.
Processor Module	Module with CPU that runs the application.
Process Station	Process station is a descriptive name for Advant products. A process station is an entity in which control applications are running. It includes the process I/O. C.f., *controller*.
RAM	**R**andom **A**ccess **M**emory.
Redundancy	Redundancy in general means the existence of more than one capability of an item (system, apparatus, component) to perform its intended function.
Re(start)	Phases of the re(start) process include, for example, power-up diagnostics and node initialization. In case of Advant Controller 110 during the initialization phase a *cold start* or *warm start* is performed depending on START MODE selector of the Processor Module.
Submodule Carrier	A submodule carrier is a module (circuit board) which houses smaller *modules* (submodules).
Subrack	According to IEC 916, subracks (equipment frames) are the mechanics which house rows of modules. Different types of subracks are available, for example, Basic Subrack, extension subrack.
Warm Start	In case of Advant Controller 110 the system software of the CPU restarts the application program without initializing its variables.

1.5 Product Overview

The S600 I/O is highly modularized and flexible so that the I/O modules can be combined to suit many applications. The S600 I/O is used by Advant Controller 110 and Advant Controller 160 as its I/O device.

1.5.1 Hardware Components listed in Functional Groups

See below a complete list of all types of hardware components—listed in functional groups—related to Advant Controller 160 and its S600 I/O.

A reference is given telling you where to find a module description, including important technical data:

- “S600” refers to *S600 I/O Hardware Reference Manual /Revision B*, chapter 3 *Data Sheets*.
- “AC160” refers to this manual, chapter 3 *Data Sheets.*

Table 1-1. Hardware Components listed in Functional Groups

Type	Denomination	Reference to description
	Analog input modules	
AI610	Analog input module	S600
AI620	Analog input module	S600
AI625	Analog input module	S600
AI630	Analog input module	S600
AI635	Analog input module	S600
AX646	Analog input module	AC160
	Analog output modules	
AO610	Analog output module	S600
AO650	Analog output module	S600
	Mixed Analog modules	
AX645	Mixed Analog module	AC160
	Digital input modules	
DI610	Digital input module	S600
DI620	Digital input module	S600
DI621	Digital input module	S600
DI622	Digital input module	S600
DI635	Digital input module	S600
DI636	Digital input module	S600
DI650	Digital input module	S600
DI651	Digital input module	S600
DI652	Digital input module	S600

Table 1-1. Hardware Components listed in Functional Groups (Continued)

Type	Denomination	Reference to description
DI685	Digital input module	AC160
	Pulse counter modules	
DP620	Pulse counter module	S600
DP640	Pulse counter module	AC160
	Digital output modules	
DO610	Digital output module	S600
DO620	Digital output module	S600
DO625	Digital output module	S600
DO630	Digital output module	S600
DX610	Digital output module	AC160
TK612	Bus cable	S600
CI610	Bus extender module for I/O Station	S600, AC160
CI615	Bus extender module for Basic Station	S600, AC160
TK610	Bus extension cable	S600, AC160
TC610	Terminator for bus extension	S600, AC160
	Communication modules	
CI626	AF 100 communication module (coax cable)	S600
CI627	AF 100 communication module (twisted pair)	S600
CI630	AF 100 communication module (coax cable)	AC160
CI631	AF 100 communication module (twisted pair)	AC160
CI670	MasterFieldbus communication module (slave)	S600
CI671	MasterFieldbus communication module (master)	S600
SC610	Submodule carrier	S600
CI532V01	RCOM communication submodule	RCOM
CI532V02	MODBUS communication submodule	MultiVendor Interface MODBUS
CI532V03	Siemens 3964R communication submodule	MultiVendor Interface Siemens 3964R
	Other components	

Table 1-1. Hardware Components listed in Functional Groups (Continued)

Type	Denomination	Reference to description
RF615	Basic Subrack	S600
RF620	Extension subrack	S600
RC610	Cable duct	S600
RC620	Fan unit	S600
TF620	Front connector for I/O modules	S600
TK630	Process cable with front connector	S600
TK640	Screened process cable with front connector	S600
RB601	Dummy module	S600

1.5.2 Data Sheets for Hardware Components

Information about the S600 I/O hardware components are represented as data sheets. For each component, there is one data sheet containing detailed informations about that component.

In Chapter 3, Data Sheets, you will find data sheets of all components of the S600 I/O that are used especially for Advant Controller 160. They are listed in alphabetical order.

1.5.3 Contents of Data Sheets

In general, the data sheet of a S600 I/O hardware component contains the following informations:

- Heading
- Summary
- Associated data base elements
- Technical data
- Front view
- Process connections
- Functional description.

Heading

In the heading of the data sheet, the type of the hardware component is given, for example AI610.

Summary

The summary provides a brief description of the hardware component.

Associated data base elements

This part informs, which (if any) data base elements are associated to the hardware component.

Technical data

The technical data of the hardware component are given in a table.

Front view

A drawing of the hardware component.

Process connections

Here you find examples of how to connect the I/O module to the process. If the hardware component is not an I/O module, the example explains how to connect it to other components.

Functional description

The functional description gives detailed information about the hardware component and its functions.

Chapter 2 Installation and Maintenance

2.1 Safety Regulations

Always follow the instructions below when installing and operating an Advant Controller system to minimize the risks of injury to personnel and damage to the equipment. Local statutory regulations, to the degree that they are stricter than the following instructions, take precedence.

2.1.1 Personnel and Process Safety

DANGER

Observe the following:

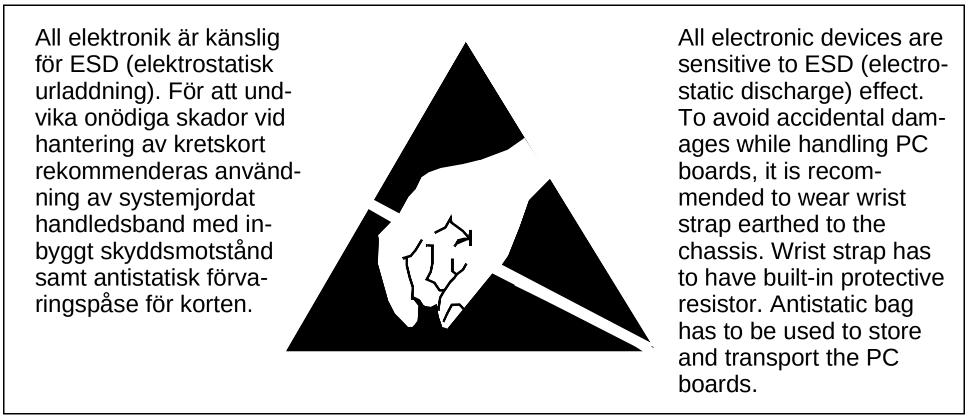
- Use only approved hoisting equipment when lifting cabinets. See lifting instructions enclosed with the cabinet.
- Never switch on the voltage supply of the cabinet during installation work.
- **Work with care when supply voltage is applied in the system. The voltage in the cabinet can cause injury and can even kill a human being.**
- Make sure that everyone working on the installation knows the location of the safety switch and the main power supply switch to the Advant Controller 160 equipment and how to use it.
- When the subsections of the process are checked and a test run has been performed, a responsible person is to check out interlocking chains, and so on. Inform all assembly personnel about test runs to be performed.
- Process technicians are to be present when testing and operating the process objects.
- Never press the system INIT (initialization) button if you do not know what happens in the system with an initialization.
- Remember that the control system can be controlled from an engineering station connected at another node via Advant Fieldbus 100. For example it can be stopped, configured and started remotely.
- Remember that an Advant Controller 160 starts automatically when voltage is applied if this is not prevented by setting the START MODE selector to the STOP position.

2.1.2 Machine Safety

CAUTION

Observe the following safety rules:

- Avoid discharges of static electricity by grounding both yourself and tools before handling circuit boards and other parts of the equipment.
- Use the grounded wristband installed in the cabinet and the available folding working surface (service shelf) when handling parts of the system.
- Handle the circuit boards carefully, particularly those which contain MOS components which can be damaged by static electricity discharges. Note the warning label on the circuit boards.
- Use, as far as possible, the grounded wristband when handling boards not stored in envelopes of conductive plastic. This gives optimum protection against static electricity discharges.
- Always store circuit boards in envelopes of conductive plastic when not installed in the system rack.
- Always switch off the voltage before extracting a board which cannot be exchanged while under voltage. Wait a sufficient time for the capacitors to discharge.
- Switch off voltage to the system and withdraw all boards at least 20 mm before electrical welding is performed near the controller system.
- A warning label is fixed in the system to draw attention to possible damage by ESD (Electro Static Discharge).



All elektronik är känslig för ESD (elektrostatisk urladdning). För att undvika onödiga skador vid hantering av kretskort rekommenderas användning av systemjordat handledsband med inbyggt skyddsmotstånd samt antistatisk förvaringspåse för korten.

All electronic devices are sensitive to ESD (electrostatic discharge) effect. To avoid accidental damages while handling PC boards, it is recommended to wear wrist strap earthed to the chassis. Wrist strap has to have built-in protective resistor. Antistatic bag has to be used to store and transport the PC boards.

Figure 2-1. Warning Label regarding ESD

2.2 Visual Inspection

Inspect the Advant Controller 160 system at intervals which depend on environmental factors such as vibration, air pollution and temperature.

2.2.1 Safety

Check that all screwed connections are properly tightened. Ensure that wiring, modules and other electrical components are undamaged. Pay particular attention to signs of overheating, damaged isolation or wear.

2.2.2 Cleanliness

Remove dust, and so on, from the cabinet with compressed air or a vacuum cleaner. Use a lint-free cloth dampened with methylated spirits to remove stubborn dirt.

2.2.3 Air Filter

If an air filter is included in the equipment, wash it in warm water with a mild detergent at intervals determined by the prevailing environmental conditions. Replace the filter after it has been washed three times. The new filter must be an approved spare.

2.2.4 Forced Cooling

If a fan is fitted, check its operation, too.

2.3 Module Replacement

2.3.1 General

User support for maintenance (and especially for module replacement) has been designed into Advant Controller 160. The system supports you to replace or insert a module during operation.

The system has the following important built-in hardware and software measures designed to cope with the special situation of module replacement:

- When the process connector is removed, the system registers this, error signals are set on DB elements and updating of the “VALUES” is discontinued. Operation of the module is inhibited (the green LED RUN extinguishes) and the outputs are switched off.
- Precautions have been taken (for example, leading ground pins on the bus connectors, and so on) to ensure that whenever a module is withdrawn or inserted, the rest of the system is not disturbed.
- Before an exchanged module can go into operation again, the process connector must be inserted and the diagnostic checks must all be satisfactory. The diagnostic checks include type of module and position (slot).

WARNING

Before replacing a module in a running system, it is important that you examine the consequences. Process equipment may be damaged if critical signals are not updated.

For this reason, it is essential that you know which signals are affected. For example:

- The replacement of an I/O module affects all channels on the module
- The replacement of a bus extender (for example, CI610) affects the whole I/O station.

Fully consider and understand the consequences before taking any action.

2.3.2 Replacement of an I/O Module

The system software in Advant Controller 160 automatically checks that all I/O modules are operating correctly. In the event of a defective or missing module (for example, during replacement), the module and associated signals are flagged at the “ERR” terminal of the data base elements. The signal value (VALUE) is not updated as long as the error persists.

The I/O module runs a self-testing routine following power-up and during operation. Providing no serious defect is detected, the red LED (FAULT) extinguishes. The system software checks that:

- The module is in the correct position (position)
- The module is of the right type
- The module is not defective
- The process connector is in place.

If all these points are in order, the green LED (RUN) lights up, the error flag on the data base element is reset and the module switches to the operating mode.

Before replacing output modules (analog or digital), it is advisable to isolate the output signals from the process.

Follow this procedure to replace a faulty or suspect I/O module:

- Read Section 2.1.1, Personnel and Process Safety.
- Open the front door of the module. Remove the paper strip (with the signal names) inside the front door to use again with the new module.
- Release the screw securing the process connector (about 15 turns) until it turns freely. If the module is in operation, it registers that the connector has been removed and stops operating (green LED RUN extinguishes).
- Remove the process connector.
- Release the screw securing the module (about 15 turns) until it turns freely and withdraw the module.
- Check that the new module is the same type as the old one.
- Insert the new module. Ensure that it is fully in place up to the hinge of the backplane. Tighten the module-securing screw. If the module is working correctly, the red LED (FAULT) lights briefly and then extinguishes.
- Insert the process connector and tighten the connector screw. The new module is taken into operation automatically and the green LED (RUN) lights up.
- Exchange the paper strip and close the front door.

Chapter 3 Data Sheets

3.1 AX645

3.1.1 Signal Processing

AX645 provides 16 combined input/output channels which can be used either to provide current signals to the process or to measure current signals from the process.

Each channel can be configured individually to work as input or output, that is inputs and outputs can exist on the same module.

The channels feature a fast output signal supervision which detects deviations of the actual output values from the intended output values and which detects short circuits.

The input/output ranges are 4 to 20 mA.

The channel input/outputs are electrically insulated in one group of 16 from the control system; test voltage 500 V a.c.

Transfer time: depends on the number of activated channels,

- at 4 activated inputs/outputs: cyclically updated within 2 to 4 ms,
- at 8 activated inputs/outputs: cyclically updated within 2 to 7 ms.

The resolution of the conversion is:

- 14 bits at outputs,
- 16 bits at inputs.

The accuracy is better than:

- 0.2% of the corresponding 100% value at outputs (T_a = 0 to 55 °C)
- 0.15% of the corresponding 100% value at inputs (T_a = 0 to 55 °C).

The input channels are provided with grid filters 50 Hz and 60 Hz. The filters can be switched off.

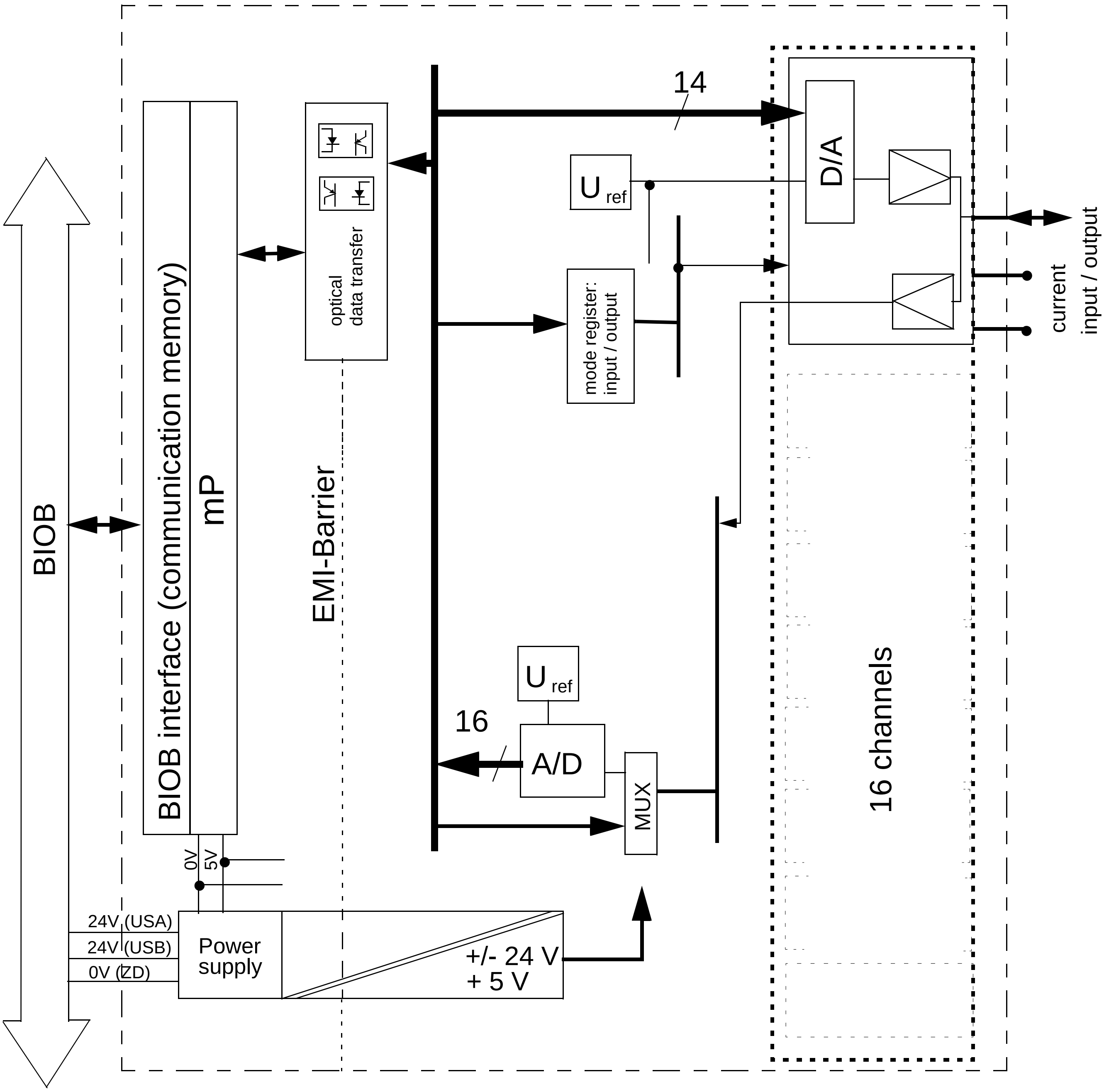


Figure 3-1. Block Diagram AX645

3.1.2 Operation Modes

Table 3-1. Operating Modes of AX645

Operating mode	Function
Analog Output	The specific channel works as analog output.
Analog Input	The specific channel works as analog input.

The device has 16 channels which can be individually configured to work either as analog current outputs or as analog current inputs.

Analog Output

The output data received via the BIOB are processed by the mP and than cyclically transferred via the EMI-barrier to the output D/A converters (14 bit converters).

The output signals are monitored, that is the actual current value of each output channel is read back and compared by the module’s mP with the intended value which was received via the BIOB. In case of deviations which exceed a configurable limit a channel error is reported to the Processor Module. The error is reported only if the deviations last longer than a configurable time period.

The supervision works as follows: If the deviation of the output current exceeds the configured limit (for example 1%) an error is reported. Additionally the output voltage is monitored for short-circuit detection: If the current is larger than 3 mA a configurable minimum output voltage (for example 200 mV) is expected.

The read-back delay of the supervision can be adjusted to the different load characteristics (that is capacity, inductance of the load).

The signal monitoring has a high coverage factor due to the fact that the output-path and the read-back path are independent from each other (for example double reference voltages, double shunts, double converters, etc.).

The AX645 monitors the cyclic update of the AX645 communication memory (BIOB interface) to detect a Processor Module failure. If the registers of the communication memory are not updated within configurable time limits the “safe-position”-values are put out.

Analog Input

The module's channels can be configured to operate as inputs.

The signal values at the inputs are converted into digital format (16 bits) and than transferred via the EMI-barrier to the mP. The mP processes the signals, filters them and puts them to the BIOB.

The inputs feature an adjustable life-zero monitoring and grid-frequency filters.

The channels provide pins for either 2-wire sensors, that is with an internal 24 V power supply from the board, or for 3-, 4-wire sensors which must be supplied from an external power supply.

About the input filters: The input signals are firstly filtered by a PT1-filter (hardware RC-filter) with a time constant of 1 ms. The signals are further filtered by a digital grid filter (notch filter) which can be configured for 50 Hz or 60 Hz or can be switched off. The digital filter introduces a time delay of half a period (20 ms or 16.6 ms).

One main emphasis lies on the fast and reliable output signal supervision as described above.

The other main feature is a short transmission delay between BIOB-interface and process-outputs / inputs.

The delay between the arrival of data at the BIOB port (that is communication memory of the module) and the input / output of these data at the concerned channel depends on the number of activated channels (the internal processing is done in four 4-channel groups):

- 1 to 4 channels activated: signal delay 2 to 4 ms
- 5 to 8 channels activated: signal delay 2 to 7 ms
- 9 to 12 channels activated: signal delay 2 to 10 ms
- 13 to 16 channels activated: signal delay 2 to 13 ms.

At inputs the numbers given above are valid only with the grid filter switched off, with activated filters the given numbers must be increased by 10 ms.

3.1.3 Diagnosis

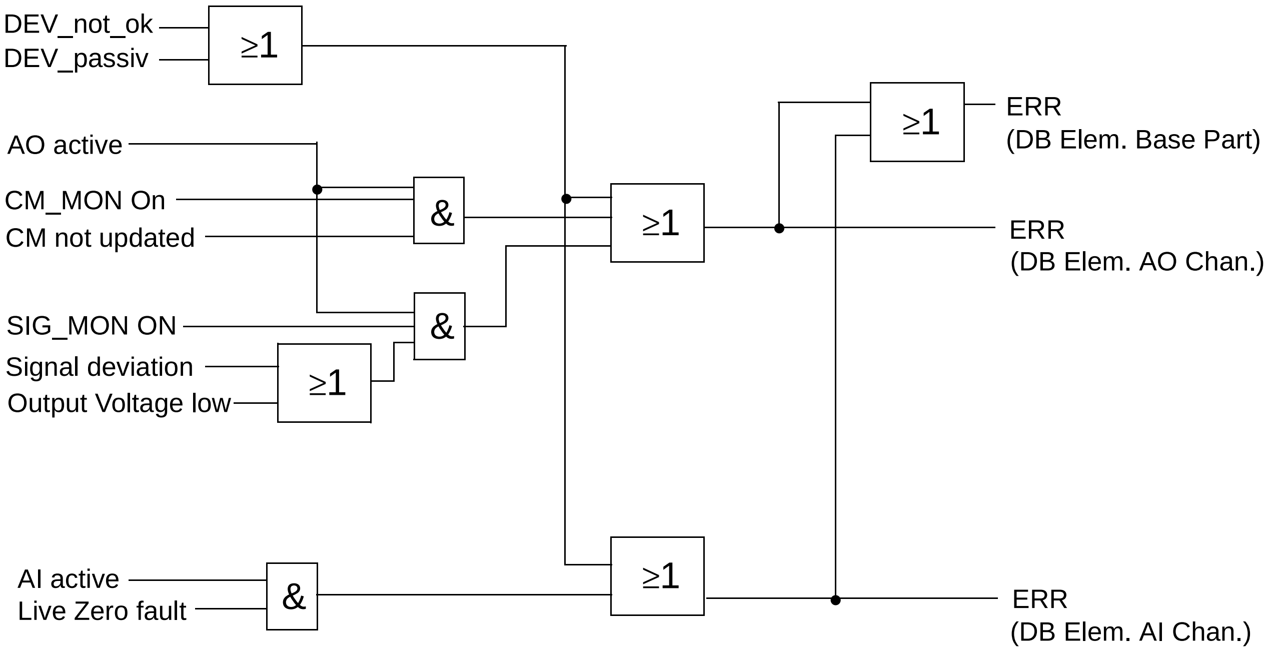


Figure 3-2. Diagnosis

The following device specific error messages appear in the Error Report of the Engineering Station:

For the AO channel:

Table 3-2. Error Report for the AO Channel

Message	Meaning
Signal deviation	The output current differs from the intended value, for example at **open circuits**.
Secondary signal value	The output voltage is lower than the parameter "MIN_VAL", for example at **short circuits**.
Refresh time out	The value in the communication memory has not been updated by the Processor Module within the time "CM_UPD" (for example Processor Module blocked).
Configuration error SETTIME>CM_UPD	Configuration error: The settling time was chosen to be longer than the update cycle-time of communication memory (that is cycle of the writing CONTRM).

For the AI channel:

Table 3-3. Error Report for the AI Channel

Message	Meaning
Live-zero error	The input current was lower than the configured LZ - limit (for example cable break).

3.1.4 Configuration

Base Part

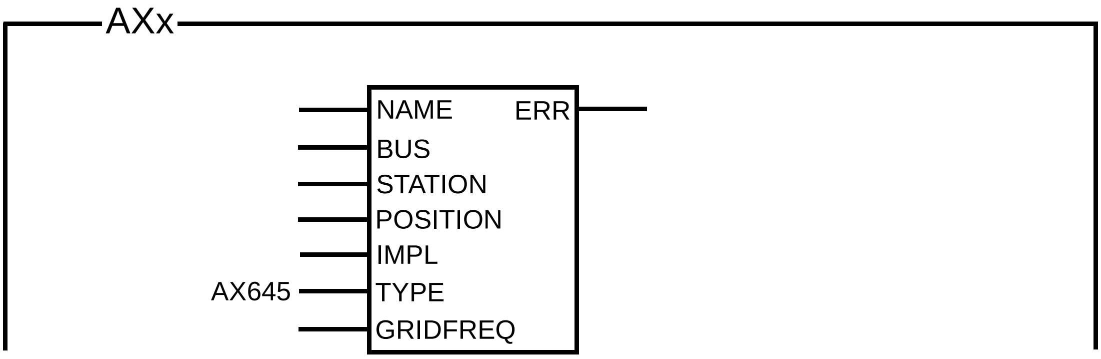


Figure 3-3. Data Base Element AX645, Base Part

The following parameters must be defined:

NAME <NAME>
Name of the module.

BUS <BUS number>
Always 0

STATION <STATION number>
determines the number of the substation in which the module is located.
Range: 0 to 7
Default: 0

POSITION <POSITION number>
determines the position number of the module in the substation.
Range: 1 to 20
Default: 0

IMPL <IMPLemented>
determines if the module will be actually implemented into the application program or not.
Range: 0 to 1
Default: 1 (implemented)

GRIDFREQ <GRIDFREQuency>
determines the filter frequency of the digital grid filter.
Range: 50 Hz, 60 Hz
Default: 50 Hz

Analog Output

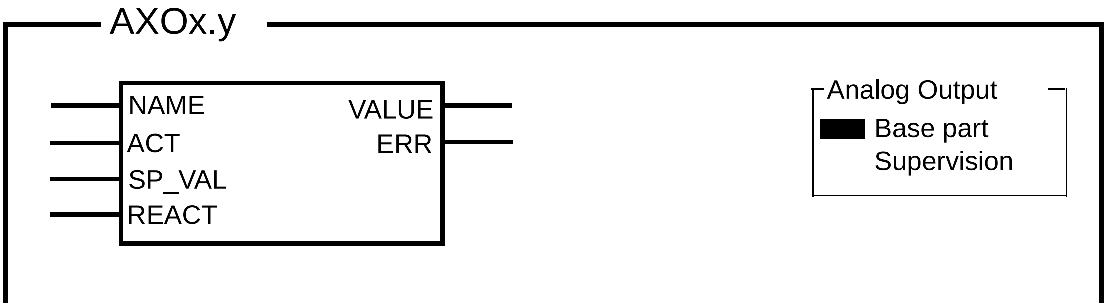


Figure 3-4. Data Base Element AXOS645, Base Part

NAME <NAME>
determines the name of the channel.
Default: AXOx.y

ACT <ACTive>
determines if the output channel is active or not.
Range: 0 = spare
1 = active
Default: 1

SP_VAL <SetPoint VALue>
determines the setpoint values which are given out in case of missing updates of the module's communication memory (Processor Module or BIOB problems).
Range: -25% to +100%
Default: 0%

REACT <REACTion>
determines the reaction of the outputs in case of errors.
Range: 1 = The setpoint values are given out.
0 = The last value is given out.
Default: 1

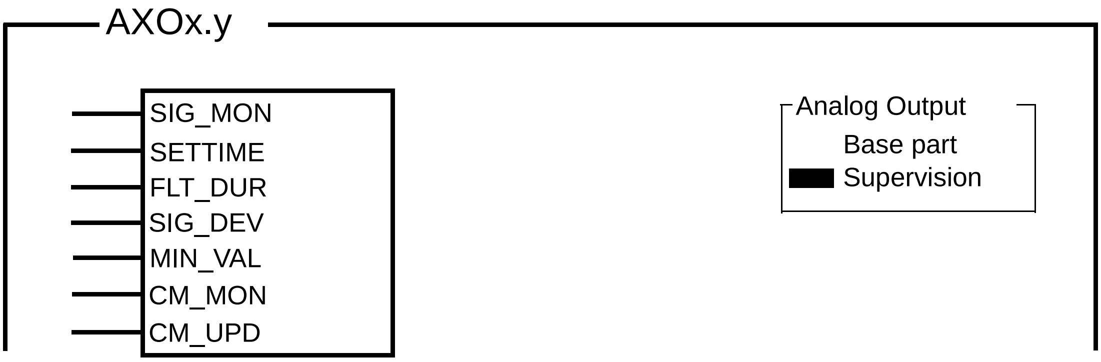


Figure 3-5. Data Base Element AXOS645, Supervision Part

SIG_MON <SIGnal MONitor>
determines if the output signal is monitored or not.
Range: 1 = monitored
0 = not monitored
Default: 1

SETTIME <SETtling TIME>
determines the time period during which the signal monitor waits for signal settling after a new value has arrived.
Range: 0 to 100 ms
Default: 1 ms

FLT_DUR <FauLT DURation >
determines how long a signal fault has to last until it is announced to the system
Range: 0 to 100 ms
Default: 1 ms

SIG_DEV <SIGnal DEViation>
determines the maximum allowable deviation of the actual output current from the intended value. This limit is used to detect for example open circuits at the output.
Range: 1% to 10%
Default: 2%

MIN_VAL <MINimum VALue>
determines the allowable minimum voltage at the output. This limit is used to detect short circuits at the output. The monitor is active at output currents larger than 3 mA. For the calculation of the limit the minimum resistance of the circuit at the output (cabling, load resistance) has to be multiplied with 0.002: $MIN\_VAL < (RL \times 0.002)$
Range: 0.0 to 10.0 V
Default: 0.2 V

CM_MON <Communication Memory MONitor>
determines if the cyclic update of the communication memory is monitored or not.
Range: 1 = monitor active
0 = monitor not active
Default: 1

CM_UPD <Communication Memory UPDate time>
determines the maximum time span within which the data in the module’s communication memory should be refreshed by the Processor Module. CM_UPD must be larger than the cycle time of the “writing” CONTRM in the Processor Module.
Range: 1 to 1000 ms
Default: 100 ms

Analog Input

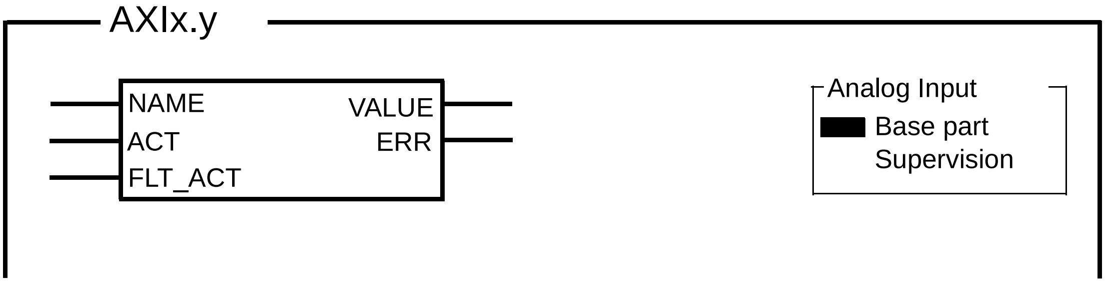


Figure 3-6. Data Base Element AXIS645, Base Part

NAME <NAME>
determines the name of the channel
Default: AXIx.y

ACT <ACTive>
determines if the input channel is active or not.
Range: 0 = spare
1 = active
Default: 0

FLT_ACT <FiLTer ACTive>
determines if the grid filter is active or not.
Range: 0 = not active
1 = active
Default: 1

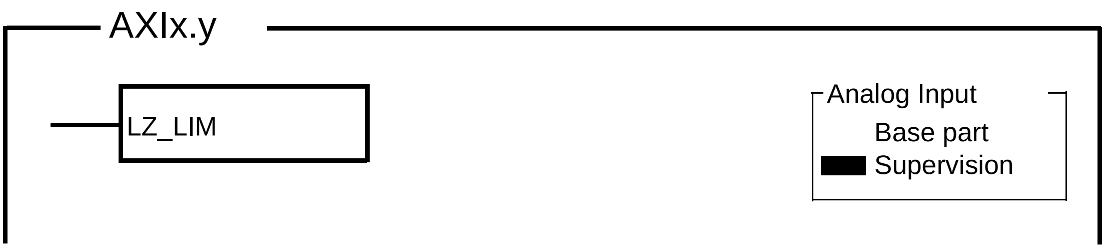


Figure 3-7. Data Base Element AXIS645, Supervision Part

LZ_LIM <Live Zero LIMit >
determines the limit value of the live zero supervision (cable break supervision)
Range: 0.0 to 4.0 mA
Default: 2.0 mA

3.1.5 Technical Data

Table 3-4. AX645 Technical Data

Analog Input / Output Module	AX645
Number of channels	16
Operating modes (per channel)	Analog Input Analog Output
Connector type on module	50 pin front connector
Type of input signals	4 to 20 mA
Type of output signals	4 to 20 mA
Electrical characteristics of **inputs**	
a) **Inputs** for internally supplied 2-wire sensors (between INOUT_x and Z_x)	
current	0 to 23 mA (-25 to +118.75%)
supply voltage: (INOUT: pos, Z: neg.)	min. 20 V (@ 23 mA) max. 25 V (@ 0 mA)
	short circuit proof (between INOUT and Z)
b) **Inputs** for externally supplied 4-wire sensors (between INOUT_x and Z-S_x)	
current	0 to 23 mA (-25% to +118.75%)
input resistance	43 W (overload proof, max. voltage INOUT and Z-S: 30V)
Electrical characteristics of **outputs**	
(load between INOUT_x and Z_x)	
current	0 to 23 mA (-25% to +118.75%)
load resistance	0 to 600 W short circuit proof

Table 3-4. AX645 Technical Data (Continued)

Analog Input / Output Module	**AX645**
Transfer characteristics of **inputs**	
• resolution	16 bits at 23 mA
• accuracy	0.15% (0 to 55 °C)
• transfer delay	1 to 4 channels active: 2 to 4 ms 5 to 8 channels active: 2 to 7 ms 9 to 12 channels active: 2 to 10 ms 13 to 16 channels active: 2 to 13 ms
• Input Filter	
• hardware (RC)	first order low pass, t = 1 ms
• software	grid filter 50 Hz, 60 Hz, OFF attenuation: 40 dB delay 10 ms
Transfer characteristics of outputs	
• Resolution	14 bits at 23 mA
• Accuracy	0.2% (0 to 55 °C)
• Transfer delay	1 to 4 channels active: 2 to 4 ms 5 to 8 channels active: 2 to 7 ms 9 to 12 channels active: 2 to 10 ms 13 to 16 channels active: 2 to 13 ms
Delay of signal fault detection	1 to 4 channels active: 2 to 4 ms 5 to 8 channels active: 2 to 7 ms 9 to 12 channels active: 2 to 10 ms 13 to 16 channels active: 2 to 13 ms
Power consumption from BIOB 24 V	8 W

Environmental Conditions

Normal operation at the following conditions:

Table 3-5. AX645 Climatic Conditions

Parameter	Limits	Test method	Test conditions	Complied standards
Ambient temperature	0–55 °C (0–70 °C for print)	IEC 68-2-2 test Ba IEC 68-2-1 test Aa	16 h 16 h	DIN EN 60721-3-9
Temperature gradients	±10 °C/h	IEC68-2-14 test Nb	0/70 °C 3 °C/min 5 cycles	IEC 65A
Humidity	95% RH classification 3K4, non condensing	IEC 68-2-3	40 °C, 93%RH 4 days	DIN EN 60721-3-9
Atmospheric pressure	106 to 70 kPa class 3K4	IEC 68-2-13	–	DIN IEC 721-3-3

Mechanical Conditions

Table 3-6. AX645 Mechanical Conditions

Parameter	Limits	Test method	Test conditions	Complied standards
Vibration	–	IEC 68-2-6	0.15 mm/10–58 Hz 2 g / 58–150 Hz 10 cycles, x, y, z-axis	DIN IEC 654-3

Electrical Conditions

Table 3-7. AX645 Electrical Conditions

Parameter	Test method	Test conditions	Complied standards
Electrostatic discharge	IEC 801-2	8 kV air, 6 kV contact, severity level 3	DIN EN 60 801 T2
Electromagnetic field, radio frequency interference (radiated)	IEC 801-3	10 V/m level 3	DIN V ENV 50 140 (IEC 801-3)
Fast transients / bursts	DIN VDE 0843 T4 (IEC 801-4)	2 kV, lev. 4	DIN VDE 0843 T4 (IEC 801-4)
Surge voltage	DIN VDE 0843 T5 IEC 801-5	2 kV CMV; lev. 3 1 kV DMV	DIN VDE 0843 T5 IEC 801-5
Conducted disturbances, induced by fields 9 kHz to 80 MHz	DIN VDE 0843 T6 IEC 801-6	10 V, level 3	DIN VDE 0843 T6 IEC 801-6
Damped oscillation	IEC 77B(Sec)116	2 kV CMV, level 3 1 kV DMV	IEC 77B(Sec)116
Galvanic isolation	DIN VDE 0160 IEC664-1, IEC664-3	500 V rms/50 Hz/1 min.	DIN VDE 0160 IEC664-1, IEC664-3

3.1.6 Process Connection

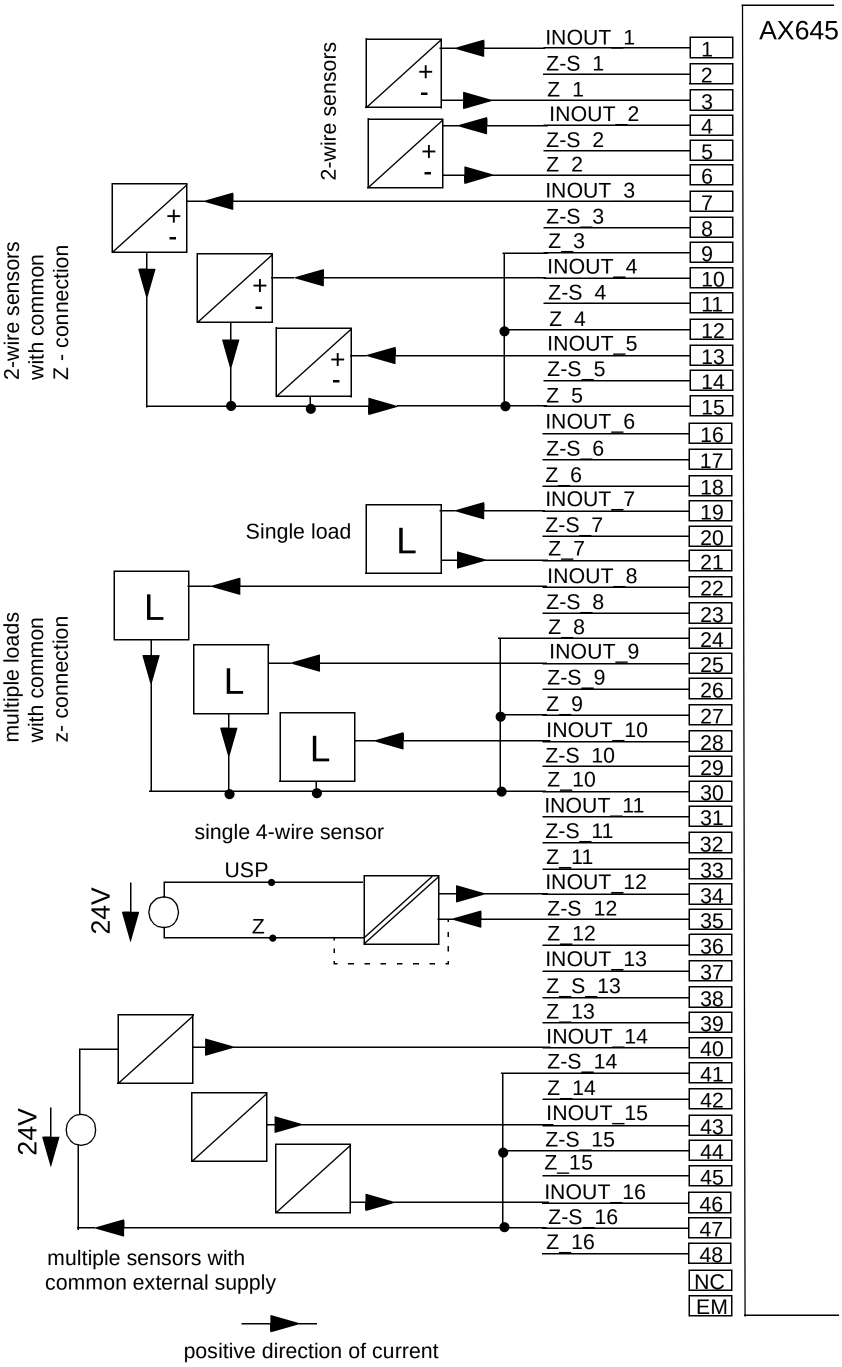
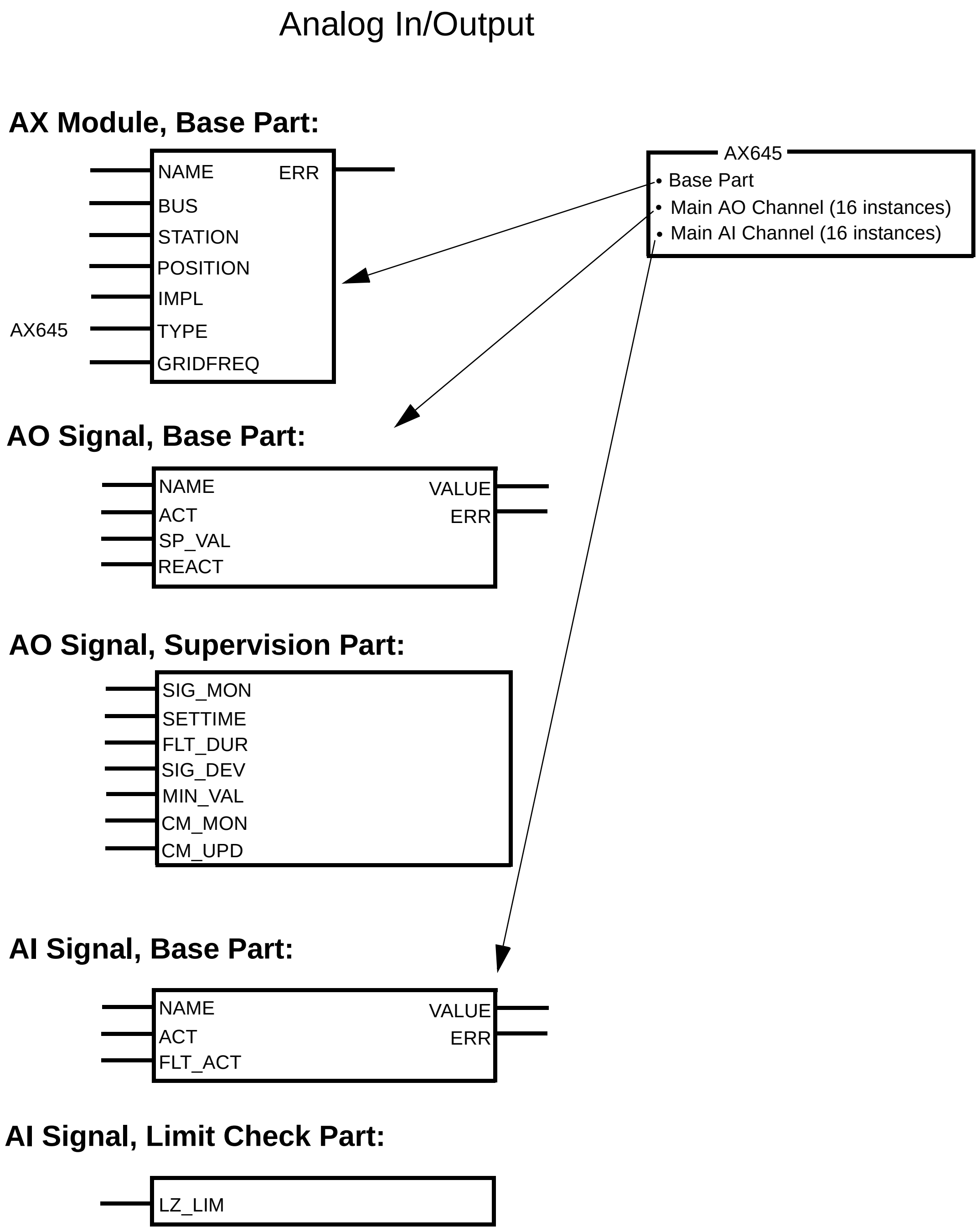


Figure 3-8. AX645 Connection Diagram

3.1.7 Data Base Elements

Overview



AX Module

Base Part:

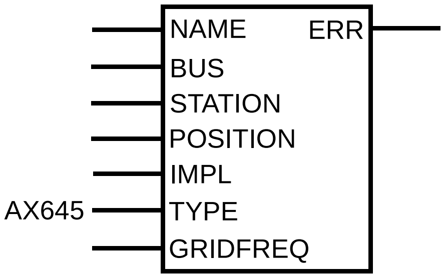


Table 3-8. AX645 Module Data Base Element

Terminal name	**Value entered by: (type)**	**Default value**	**PC connection: Data type (Access mode by PC prog.)**	**Description**	**Remarks**
Name	user (Text)	AXx	–	unique board name	max. 20 characters
BUS	predef (I)	0	–	BUS number	–
STATION	user (I)	0	–	Station number	–
POSITION	user (I)	0	–	POSITION of the board within the station	–
IMPL	user (B)	1	–	0 = spare 1 = implemented	–
TYPE	predef	AX645	–	Module Type	–
GRIDFREQ	user	50 Hz	–	Filter frequency 50 Hz 60 Hz	–
ERR	system (B)	–	B(r)	Board error 0 = no error 1 = non functional module, system err., signal deviation at output, LZ at input	–

Analog Output

Base Part:

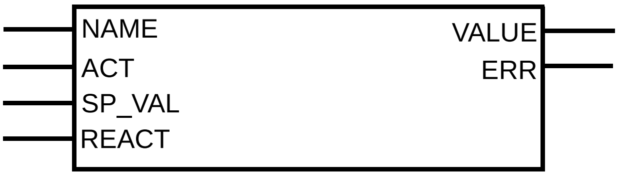


Table 3-9. AX645 Outpur Signal, Base Part

Terminal name	Value entered by: (Data type)	Default value	PC connection: Data type (Access mode by PC prog.)	Description	Remarks
Name	user (Text)	AXx.y	–	unique signal NAME	max. 20 characters
ACT	user (B)	1	–	channel is: 0 = spare 1 = ACTive	–
SP_VAL	user (R)	0.0	–	SetPoint VALue in percent of nominal range; in case of OSP or missing CM update this value is put out.	-25% to +100% equiv. 0 to 20 mA
REACT	user (B)	1	–	REACTion parameter 0 = keep current output value 1 = set output value to SPVAL	–

Table 3-9. AX645 Outpur Signal, Base Part (Continued)

Terminal name	**Value entered by: (Data type)**	**Default value**	**PC connection: Data type (Access mode by PC prog.)**	**Description**	**Remarks**
VALUE	system	–	IL(r/w)	Process VALUE	0 to 16383 equiv. -25% to +18.75% equiv. 0 to 23 mA (0% to 100% equiv. 4 to 20 mA)
ERR	system	–	B(r)	ERRor. 0 = no error 1 = hardware or sys. error, signal deviation at output missing CM update	–

Analog Output, Supervision Part:

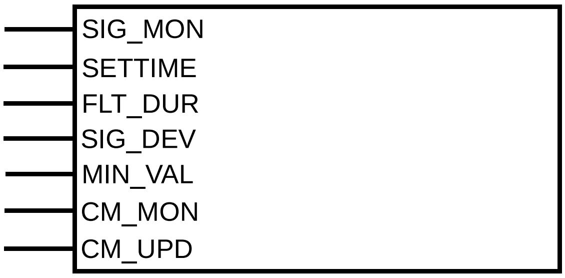


Table 3-10. AX645 Output Signal, Supervision Part

Terminal name	Value entered by: (Data type)	Default value	PC connection: Data type (Access mode by PC prog.)	Description	Remarks
SIG_MON	user (B)	1	–	SIGnal MONitor. 1 = active 0 = inactive to switch on or off the signal monitor	–
SETTIME	user (I)	2 ms	–	SETtling TIME 0 to 100 ms time period after which the monitor starts to check the output signal	–
FLT_DUR	user (I)	4 ms	–	FauLT DURation. 0 to 100 ms A signal deviation must last min. FLT_DUR to trigger the monitor	–

Table 3-10. AX645 Output Signal, Supervision Part (Continued)

Terminal name	**Value entered by: (Data type)**	**Default value**	**PC connection: Data type (Access mode by PC prog.)**	**Description**	**Remarks**
SIG_DEV	user (R)	2%	–	SIGnal DEViation. 1 to 10% of nominal range Permissible signal deviation	–
MIN_VAL	user (R)	0.2 V	–	MINimal VALue. 0 to 10 V Minimal voltage at output; a lower voltage will trigger the monitor.	–
CM_MON	user (B)	0		Communication Memory Monitor 1 = cyclic update is monitored 0 = no monitoring	–
CM_UPD	user (I)	100 ms	–	Communication Memory UPDate 1 to 1000 ms If the CM is not updated within this time the SP_VAL is put out.	–

Analog Input

Analog Input, Base Part:

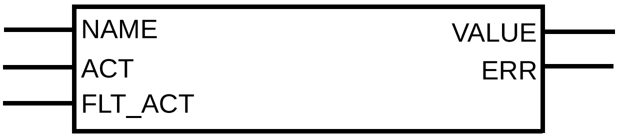


Table 3-11. AX645 Input Signal, Base Part

Terminal name	**Value entered by: (Data type)**	**Default value**	**PC connection: Data type (Access mode by PC prog.)**	**Description**	**Remarks**
NAME	user (Text)	AXx.y	–	unique signal NAME	max. 20 characters
ACT	user (B)	0	–	channel is: 0 = spare 1 = ACTive	–
LT_ACT	user (B)	1	–	grid filter is: 1 = active 0 = not active	–
VALUE	system	–	IL(r)	Process VALUE	0 to 65535 equiv. -25% to +118.75% equiv. 0 to 23 mA (0% to 100% equiv. 4 to 20 mA)
ERR	system	–	B(r)	ERRor. 0 = no error 1 = hardware or configuration error, live-zero or overrange at input	–

Analog Input, Limit Check Part:

Table 3-12. AX645 Input Signal, Limit Check Part

Terminal name	**Value entered by: (Data type)**	**Default value**	**PC connection: Data type (Access mode by PC prog.)**	**Description**	**Remarks**
LZ_LIM	user (R)	2 mA	–	Live-Zero LIMit 0 to 4 mA limit value for live-zero supervision;	–

3.2 AX646

3.2.1 Summary

The AX646 module provides 16 input channels for current measurement 4 to 20 mA and 16 output channels for internal testing of the module. The output range is 0 to 20 mA.

In test mode the output signals are looped back internally on the AX646 to test the input circuits. The output values are not available to the user. During test mode, the sensor power supply and the sensor load remains on.

The AX646 can not be shared among different Processor Modules if test mode is used.

The channel input/outputs are electrically insulated in one group of 16 from the control system and the electronic power, but there is no channel-to-channel isolation. Test voltage is 560 V a.c..

Transfer time for all channels is less than 16 ms.

The resolution of the conversion is16 bits for the input- and 14 bits for the output channels.

The over all accuracy (temperature drift, aging, component tolerance) is better than 0.39% of the corresponding 100% value (T_a = 0 to 55 °C).

The input channels are provided with grid filters 50 Hz, 60 Hz. The filters can be switched off per channel. The sample period is 10 ms for 50 Hz filter and 8 ms for 60 Hz filter.

A special PC-Element (PC_AX646) is available for Boiler Protection Systems to operate and check the AX646 module.

3.2.2 Associated Data Base Element

Associated data base elements are AX646 for the module, AXIS646 for its input and AXOS646 for its output channels.

3.2.3 Module Replacement

On-line replacement is possible. In case of insertion or replacement of the module or in case of sensing of power the module automatically initializes. No jumpering and no adjustments required.

3.2.4 Technical Data

Table 3-13. AX646 Technical Data

Analog Input	**AX646**
Number of inputs	16
Type of input signals	Single-ended
Operating modes per module	Analog input, analog output, test mode Input test mode: - analog output looped back internally to check input circuits. Outputs are not accessible by the user.
Measurement range	4 to 20 mA
Overrange	0 to 23 mA (-25% to +118.75%)
Maximum input current	33 mA for 5 Minutes
Live zero error	Adjustable channel wise, default 3.5 mA
Isolation between System and all Inputs	Yes
• Test voltage	560 V_{rms}
Input resistance	150 Ω
Analog input error	
• Max. error at 25 °C	0.39%
• Temperature coefficient for current	0.020%/10 °C
• Max. error within the permissible temperature and supply range	0.45%
Resolution	16 bits
Filter	
• Hardware	First order low pass, t = 1 ms
• Software	Grid filter 50 Hz, 60 Hz for the module selectable attenuation: 40 db, delay 10 ms, channel wise on / off.
Conversion time for all channels	16 ms

Table 3-13. AX646 Technical Data (Continued)

Analog Input	**AX646**
Transfer time into test mode	< 60 ms
Electrical characteristics of inputs a)Inputs for internally supplied 2-wire sensors (sensor between INOUT_x and Z_x) supply voltage: (INOUT_x: pos, Z_x: neg.) b)Inputs for externally supplied 4-wire sensors (between INOUT_x and Z-S_x)	Short circuit proof (between INOUT_x and Z_x) min. 20 V (@ 23 mA) max. 25 V (@ 0 mA) Overload proof max. voltage INOUT_x and Z-S_x: 30 V)

Analog output	**AX646**
Number of outputs	16
Output range	0 to 20 mA (0 to 100%)
Isolation, test voltage	Yes, 560 V_{rms}
Load • Current output	 Internal
Analog output error • Max. error at 25 °C • Temperature coefficient for current	 0.39% 0.020%/10 °C
Resolution	14 bits
Conversion time for all channels	16 ms
Current consumption (from USA/USB) a)all inputs 2-wire sensors 10 mA b)all inputs 2-wire sensors 20 mA c)all inputs 2-wire sensors 20 mA test mode 20 mA each output	 636 mA 820 mA 1056 mA
Power dissipation • typical • max.	 12.8 W 19 W
Weight	1.12 kg

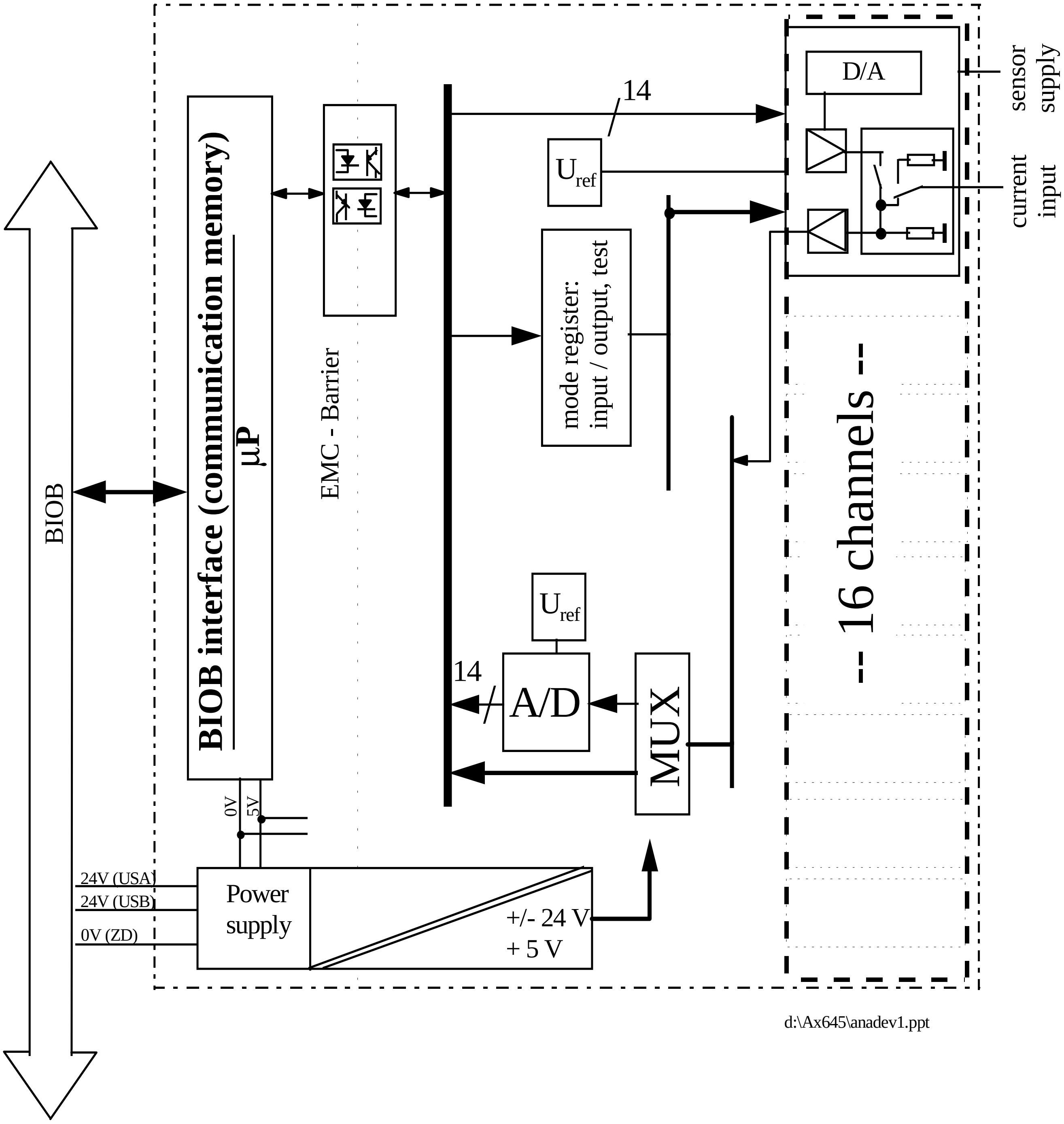


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Figure 3-9. AX646 Block Diagram

3.2.5 Operation Modes

Table 3-14. Operating Modes of AX646

Operating mode	Function
Analog Input	The specific channel works as analog input.
Analog output	The specific channel works as analog output.
Input test mode	Test of the input circuits. Analog output values looped back internally on the board.Output values not available to the user.

Functional Description Analog Input

The analog input module AX646 has 16 single-ended input channels for 4 to 20 mA. The module converts the analog input signals from transmitters to digital values required by the programmable controller. The input channels and their transmitter supply are isolated from the electronic power, but they are not isolated from each other (no channel-to-channel isolation). For the inputs a sensor power supply (24 V, 23 mA) is provided per channel. This supply is short circuit proof.

The channels provide pins for either 2-wire sensors, that is with an internal 24 V power supply, or for 3- and 4 - wire sensors which must be supplied from an external power supply.

The module is equipped with an internal processor and analog multiplexers. The input signals pass through analog and digital filters. The digital grid filter (notch filter) can be configured for 50 Hz or 60 Hz or can be switched off channel wise. The digital filter introduces a time delay of half a period (20 ms or 16.6 ms). Under program control, the multiplexer connects one measurement channel at a time to the 16 bit successive - approximation A/D converter. The A/D converter is a high speed, high accuracy converter with internal calibration and 10µsec converting time. If a severe fault is detected, the LED (FAULT) on the front of the module lights and the internal input signals are set to “0”.

There are two LEDs on the front of the module. A green LED (RUN) indicates that the module is operating normally. A red LED (FAULT) signals a severe fault.

The hardware and software signal processing in the input module AX646 involves the following procedures:

Filtering and A/D conversion

- Prefiltering and gain control
- Conversion of analog signals to digital signals
- Digital filtering.

Analog Output and Input Test Mode

The module has 16 analog outputs, which can be connected to the analog inputs internally on the board. The output range is 0 to 20 mA (0 to 100%). Output data received via BIOB are processed by the internal processor and then cyclically transferred via the EMI-barrier to the 14-bit D/A-converters. The output signals are not available to the user or a process interface. A switch to the loop back test of the input circuits is done with a binary signal from the Processor Module via BIOB (DO-channel).

If test mode is used, the cycle time of the Processor Module should not be shorter than 100 ms.

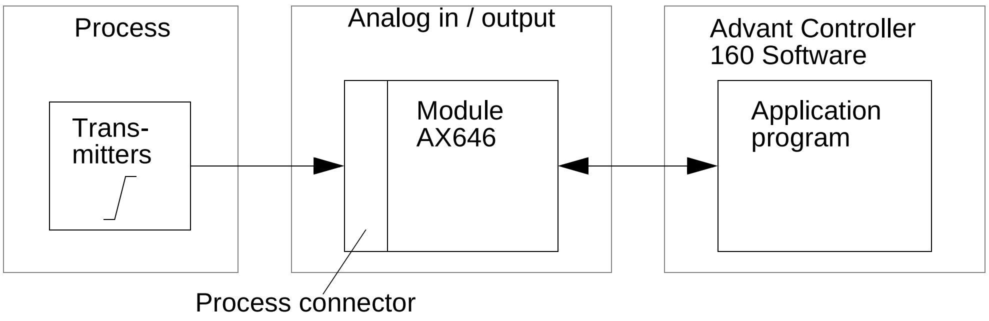


Figure 3-10. AX646 Block Diagram

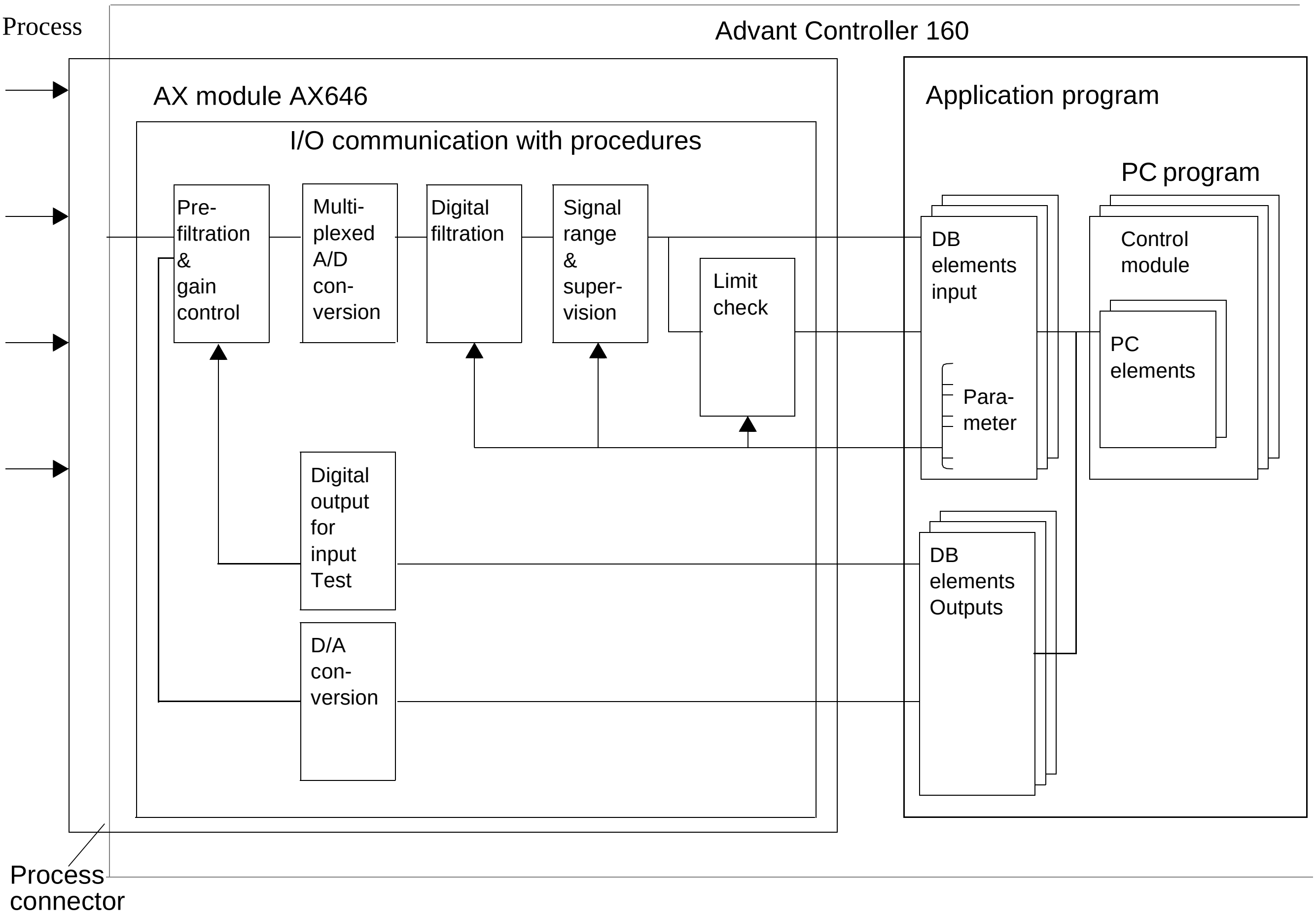


Figure 3-11. AX646 Interface to Application Program

Filtering and A/D Conversion

The input signals pass through an analog lowpass filter to remove high-frequency interference.

Filtered signals are transferred by an analog multiplexer to an instrument amplifier and conditioned for the A/D conversion.

After A/D conversion, the signals are filtered a second time by a digital filter to suppress the mains frequency interference.

Signal Range and Supervision

Excursions of the input signal outside its permissible range are indicated as an error in the data base elements. In that case, values are represented by “NAN” (Not a Number).

The AX646 checks the inputs signals for live zero, too.

Data Base Element Parameters

In the database element AX646 you can select the mains frequency to be suppressed.

In the database elements AXIS646, you can set the following parameters individually for each input channel:

- Channel active (on or off)
- Live zero value
- Filter active (on or off)
- Two low-limit values
- Two high-limit values
- One hysteresis.

You can select whether the signal shall be active or not. If the signal is designated inactive, the value for the corresponding channel in the data base element is not updated.

The limit check can supervise four limits, two low and two high. The limits have a hysteresis which is always within the limit (see figure below). Limit values and hysteresis are determined by parameters in the data base elements. The unit of limits and hysteresis are specified in a percentage.

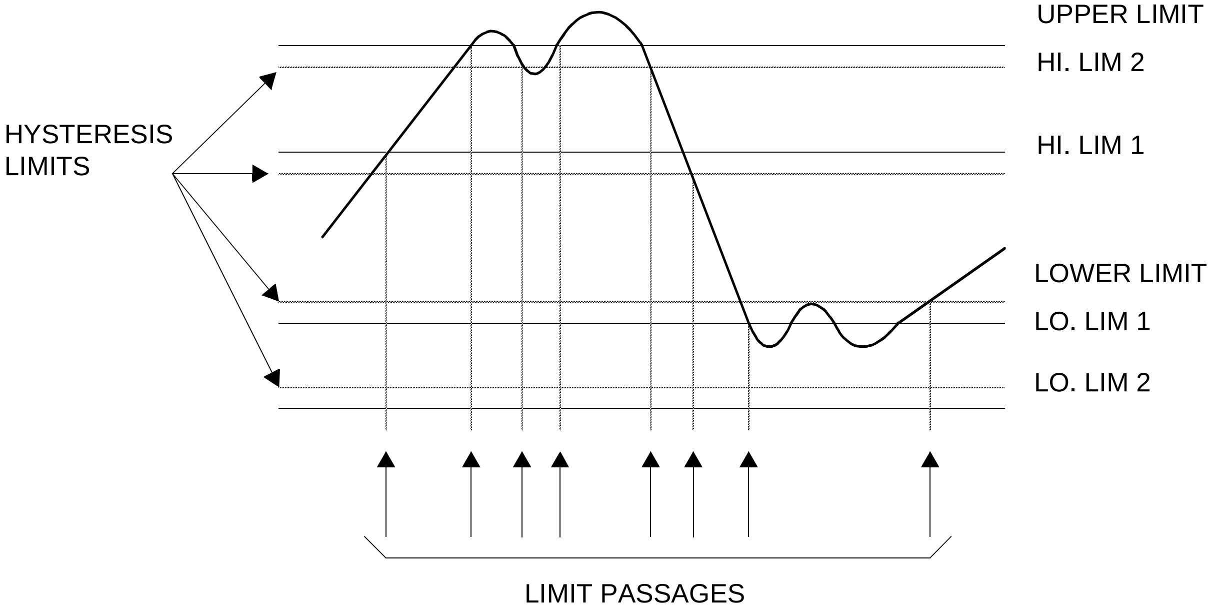


Figure 3-12. Limit check with Hysteresis

The data base elements also contain information (signals) identifying which limits have been exceeded. This information (signals) is accessible for PC elements.

3.2.6 Diagnosis

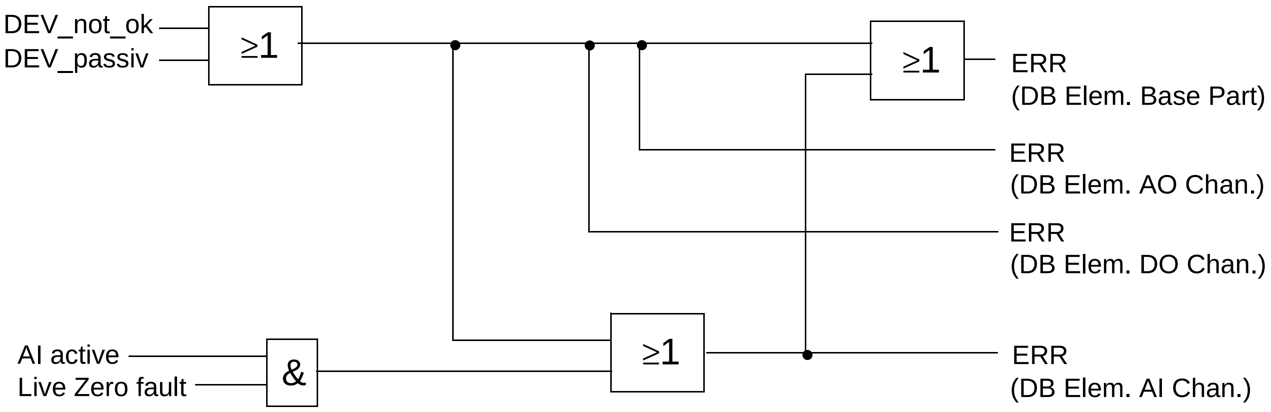


Figure 3-13. Diagnosis

The following device specific error messages appear in the Error Report of the Engineering Station:

For the AI Signal

Table 3-15. Error Report for the AI Channel

Message	Meaning
Live-zero error	The input current was lower than the configured LZ -limit (for example cable break).

3.3 CI610, CI615

3.3.1 General

An Advant Controller 160 consists of one Basic Station and up to seven I/O Stations. These are connected using the I/O extension bus.

The communication between the Basic Station and the I/O Stations is established with a CI615 bus extender in the Basic Station, a CI610 bus extender in each of the I/O Stations, and an interconnecting cable. To obtain higher availability, this installation can be made redundant, by using two CI615 in the Basic Station, two CI610 in each I/O Station and two cables. This is shown in Figure 3-14. For simplification the station are shown without possible extension subracks. The optional SA610 power supply modules are not shown as well.

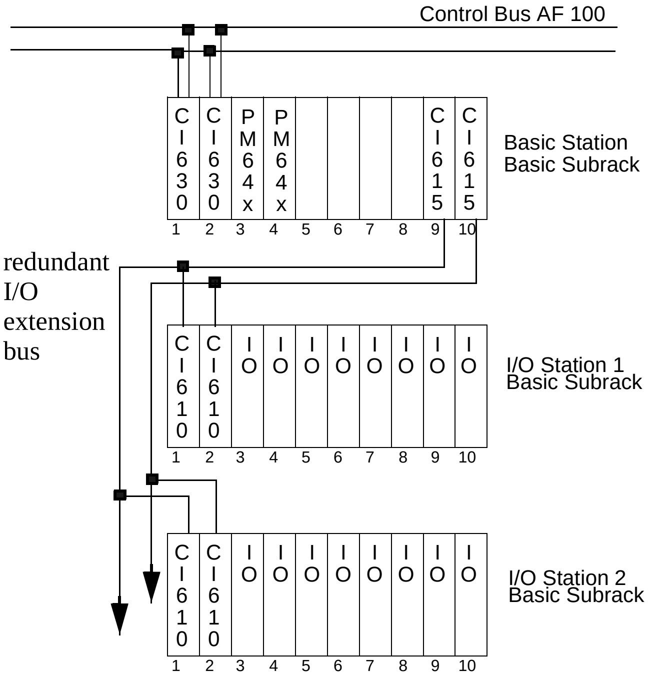


Figure 3-14. Configuration with Redundant Modules CI610 and CI615

The restrictions concerning system configuration, location of the devices, communication speed and so on will be discussed in the following sub-sections.

3.3.2 Bus Extension

If an Advant Controller 160 needs more than two subracks, it can be extended by adding I/O Stations. Adding I/O Stations to a Basic Station requires bus extenders and bus extension cables.

An extension bus can be up to 20 meters long and must always be a point-to-point connection, that is, branches and radial configurations are not permitted. A bus terminator must be mounted in the last I/O Station at the end of the bus extension cable. The termination at the near end is included in the bus extender CI615.

To obtain higher availability the extension bus can be made redundant with redundant pairs of CI615/CI610 modules.

3.3.3 Bus Extender CI615 for Basic Station

3.3.4 General

The bus extender CI615 enables you to add up to seven I/O Stations, via the I/O extension bus, to a Basic Station. For a redundant bus connection to the I/O Stations two CI615 modules can be mounted in a Basic Station. Without redundancy only one CI615 is necessary.

The main functions are:

- Data transmission from Processor Module to I/O module and vice versa
- Termination of extension bus
- Detection of open-circuit cables.

The CI615 can be in any one of the following three states:

- RESET
  This state is entered after power-up, due to a restart command from the Processor Module, or due to an active RESET signal on the backplane bus.
- PASSIVE
  This state is entered when the conditions for RESET are gone, or an active device has been passivated, due to a passive-command from the Processor Module. In this state, communication with devices in other stations is not possible.
- ACTIVE
  This state is entered as a result of an operation command from the Processor Module. In this state, the configuration and diagnostic registers can be accessed as well. Every master frame (a telegram from a Processor Module) seen on the backplane bus are put on the I/O extension bus, and slave frames (a telegram from an I/O module) from the I/O extension bus are sent back onto the backplane bus.

3.3.5 Module Description

A CI615, or two redundant CI615, can in principle be placed in any slot in the Basic Station, as a CI615 has no need for special information only present in specific slots. But they must not be placed in slot 2, because this slot is reserved for a CI630 which is mandatory.

In case of redundant set-up master frames are detected by both CI615, sent on both I/O extension bus cables, and received by both CI610 in each I/O Station. Only the active CI610 passes the master frames to, and receives the slave frames from the backplane bus in the I/O Station. Therefore only the CI615 connected to the active CI610 will receive a slave frame from the I/O extension bus and pass it on to the backplane bus in the Basic Station.

After insertion of the CI615 or of two redundant CI615 they are in their passive state. No data is sent to the I/O Stations. After the Processor Module has activated the CI615 (bus extender is set to operation and the green LED RUN is lit), the transfers on the I/O extension bus take place.

3.3.6 Switch-over Handling

The in the following named slot numbers refer to the configuration shown in Figure 3-14.

Both CI615 bus extenders are active at all times. Therefore if in I/O Station 1 the CI610 in slot 1 is active, while in station 2, the CI610 in slot 2 is active, communication with both stations 1 and 2 is possible at the same time.

If an CI615 fails, the Processor Modules soon notice it, due to time-out problems, when accessing I/O modules in stations where the active CI610 is connected to the faulty CI615. In such stations, a switch-over to the other CI610 will be forced via the second CI615. The switch-over is done within 100 ms.

Because of the cyclic switch-over of redundant CI610s from active to passive and vice versa it is guaranteed that each CI615 is connected to an active CI610. Therefore the failure of any CI615 is noticed by the Processor Modules.

3.3.7 Supervision

Whenever the power supply voltage is too low, the module remains in its reset state and the red LED FAULT is lit.

The I/O bus extension cable is monitored with respect to open circuits. If the bus extension cable is interrupted or is not terminated, an open circuit is detected. The module DB element terminal ERR becomes active.

3.3.8 Configuration

Configurable parameters:

- None.

All Processor Modules must include the CI615 DB element in the DB configuration. For redundant CI615 two DB elements CI615 must be configured.

3.3.9 Diagnostic

A supervision function sets the following bits in the diagnostic register:

- Open-circuit cable.

3.3.10 Technical Data

Table 3-16. CI615 Technical Data

Bus extender	**CI615**
Connector type	CHAMP 24 pin
Extension bus • Total cable length (TK610) • Max. number of I/O Stations	 20 m 7
Current consumption • typ.(1) • max.(2)	 146 mA 182 mA
Power dissipation • typ.(3) • max.(4)	 3.5 W 4.5 W

(1) Typical consumption from electronic power supply USA/USB.
(2) Max. consumption from electronic power supply USA/USB at min. supply voltage
(3) Total power dissipation at rated supply voltage.
(4) Total power dissipation at max. supply voltage.

3.3.11 Front View CI615

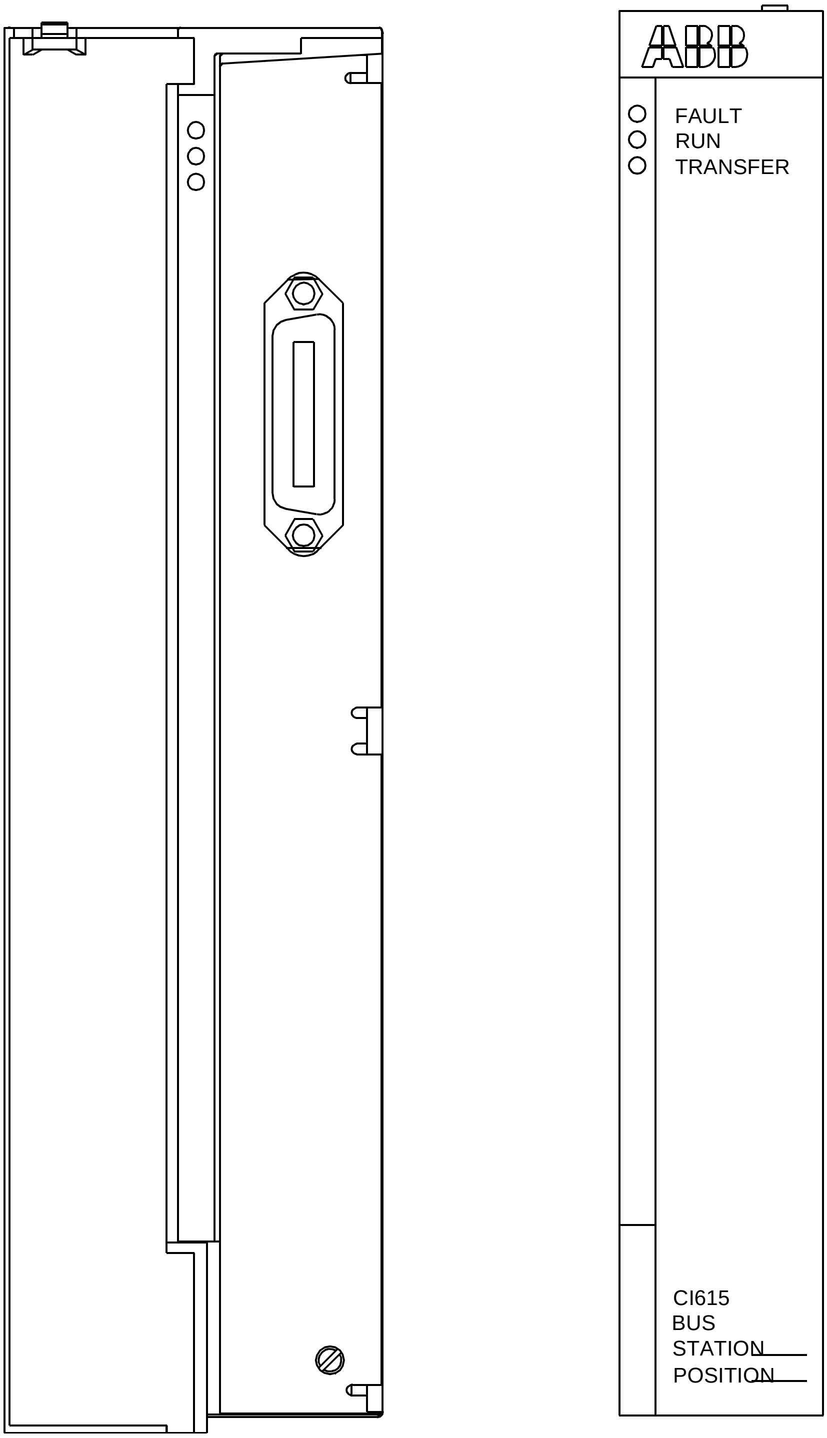


Figure 3-15. CI615 with Open Front Door (left) and Front View (right)

3.3.12 Bus Extender CI610 for I/O Station

3.3.13 General

The bus extender CI610 connects an Advant Controller 160 I/O Station to the I/O extension bus. A CI610 can be addressed and configured by the Processor Module in the same way as any I/O module.

The main functions are:

- Data transmission from I/O extension bus to the I/O Station and vice versa
- Supervision of data transfer
- System power supply supervision.

The CI610 can be in any one of the following three states:

- RESET
  This state is entered after power-up, due to a restart command from the Processor Module, or due to an active RESET signal on the backplane bus.
- PASSIVE
  This state is entered when the conditions for RESET are gone, or an active module has been passivated. The latter can be result of either a passive-command from the Processor Module or a redundant CI610 going active. In the passive state, communication with CI615 is not possible. The OSP (“output to safe position”) watchdog is active, though. that is that the OSP signal can be activated also if both of the redundant CI610s are passive. [1]
- ACTIVE
  This state is entered as a result of an operation command from the Processor Module. In this state, the configuration and diagnostic registers can be accessed as well. The received master frames are put on the backplane bus, and slave frames detected on the backplane bus are sent back on the I/O extension bus. Furthermore, the active CI610 controls the OSP and RESET signals on the backplane bus of its I/O Station. [1]

3.3.14 Module Description

The bus extender CI610, or two redundant CI610, must be placed in the first two slots of the Basic Subrack of an Advant Controller 160 I/O Station. If only one CI610 is included it must be placed in slot 1.

After insertion, CI610 is in its passive state. The CI610 module can be accessed by the system for diagnostic and configuration purposes, but no data is transferred to the I/O Station.

After the Processor Module has activated the CI610 (bus extender is set to operation and the green LED RUN is lit), the modules in the I/O Station can be accessed. Note that the station address on the Basic Station must be set in the range of 1 to 7 and must be unique.

---

[1] Output to safe position OSP is an automatic system reaction to severe controller errors and is supported if the controller contains one Processor Module only. The outputs of the controller are set to predetermined safe values in order to protect the process against system failures.
With more than one Processor Module output to safe position must be configured.

3.3.15 Switch-over Handling

Due to the requirement of being able to test the redundancy regularly, a cyclic switch-over from the active to the passive CI610 will be done (activated through the system software of the controller) to determine whether the passive CI610 is still operational.

This is easily accomplished by setting the passive CI610 active. This is noted by the active CI610, which immediately enters the passive state. Failures are detected if the commanded switch-over doesn’t function.

3.3.16 Supervision

Module Supervision

Whenever the power supply voltage is too low, the module remains in its reset state and the red LED FAULT is lit.

Power Supply Supervision

The power supply voltages USA and USB on the base backplane RF616 and USA and USB on the extension backplane RF620 are supervised by CI610. An error is signalled if the voltage is less than 17 to 15 V.

A missing power supply voltage is reported in the diagnostic register (but not signalled with the red LED FAULT). The module DB element terminal ERR becomes active.

Data Transfer Supervision

The data transfer supervision function checks the correct operation of the I/O extension bus and I/O Station.

If a severe data transfer error is detected, the CI610 stops operating.

3.3.17 Configuration

Configurable parameters:

- None.

All Processor Modules must include the CI610 DB element within the DB configuration. For redundant CI610 two DB elements CI610 must be configured.

3.3.18 Technical Data

Table 3-17. Bus Extender CI610 Technical Data

Bus extender	**CI610**
Connector type	CHAMP 24 pin
Extension bus	
• Total cable length (TK610)	20 m
• Max. number of I/O Station	7
• Station address	1 to 7
Current consumption	
• typ. (1)	146 mA
• max. (2)	182 mA
Power dissipation	
• typ. (3)	3.5 W
• max. (4)	4.5 W

(1) Typical consumption from electronic power supply USA/USB.
(2) Max. consumption from electronic power supply USA/USB at min. supply voltage.
(3) Total power dissipation at rated supply voltage.
(4) Total power dissipation at maximum supply voltage.

3.3.19 Front View CI610

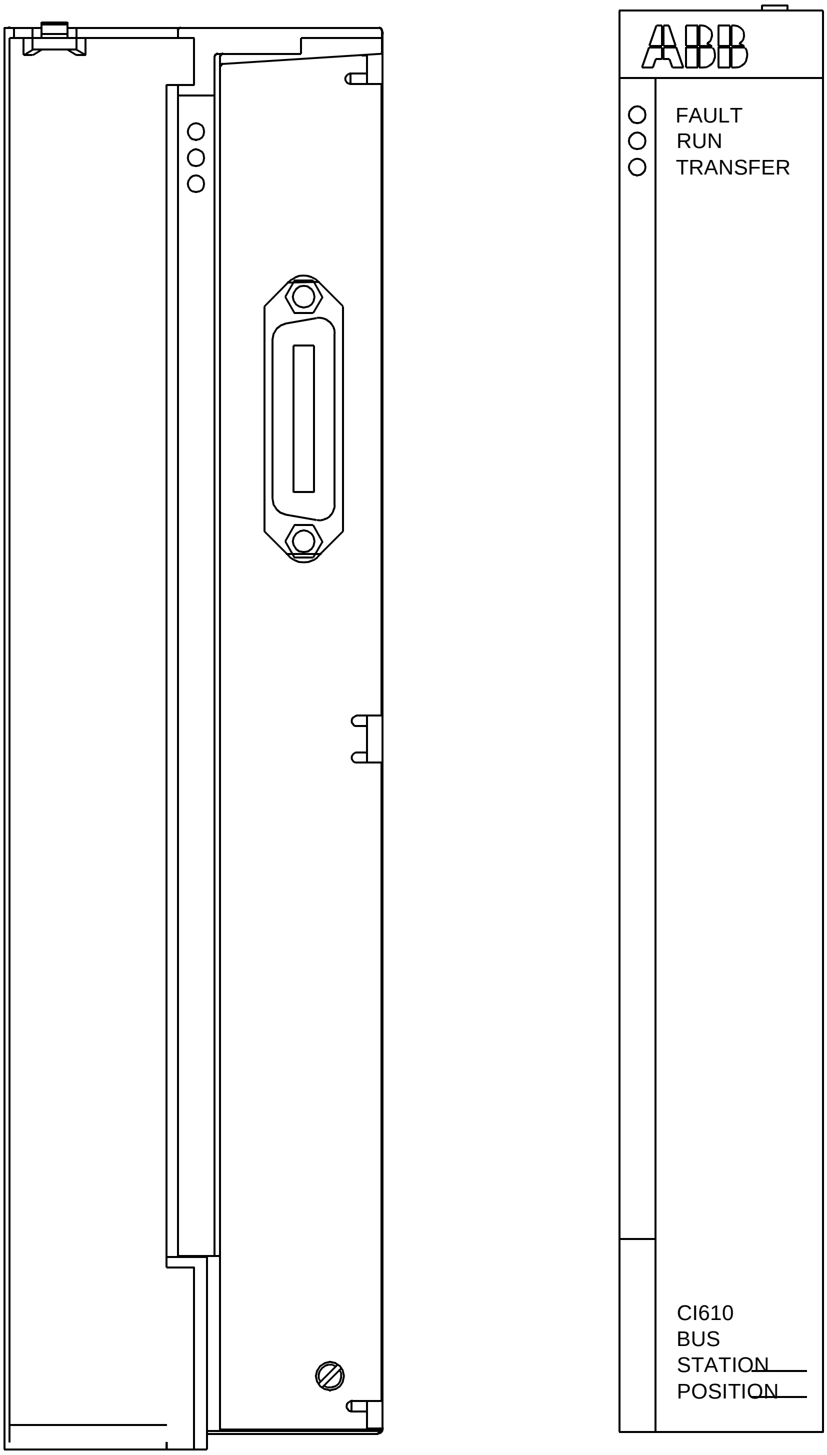


Figure 3-16. CI610 with Open Front Door (left) and Front View (right)

3.3.20 TK610

General

The bus extension cable connects an I/O Station to the Basic Station or an I/O Station to the next I/O Station. At the bus extender CI610 of an I/O Station, the incoming and outgoing cables are connected together by a back-to-back adaptor of the CHAMP 24 pin according to IEEE 488, so it is possible to replace a CI610 without interrupting the extension bus.

To fit the cable to the bus extender, two (long) screws are supplied with every cable. The screws are sufficiently long to secure together two cable plugs or one cable plug and the bus terminator.

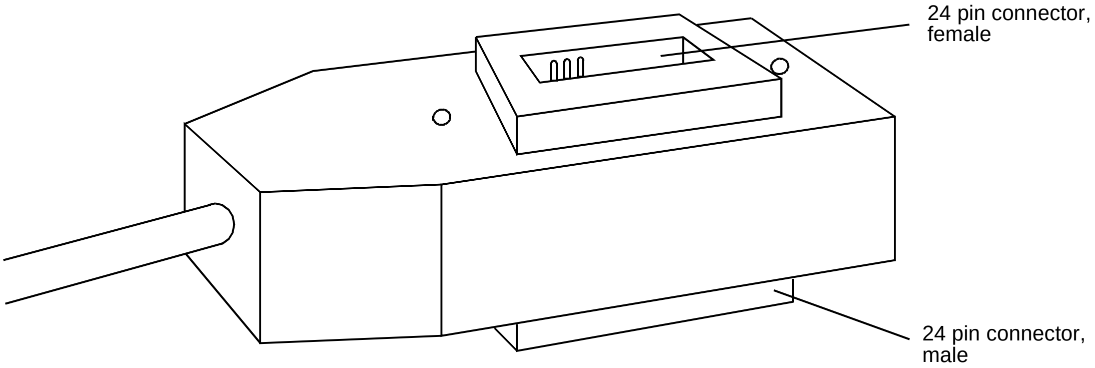


Figure 3-17. Bus Extension Cable TK610

Cable Types

Three types of bus extension cable are available. They differ only in their length.

Table 3-18. Cable Types

Name	Length	Type Designation
Bus extension cable	2.5 m	Type TK610V025
Bus extension cable	5.0 m	Type TK610V050
Bus extension cable	10.0 m	Type TK610V110.

3.3.21 TC610

An extended I/O system requires only one bus terminator for non redundant bus extension, two bus terminators for redundant bus extension. It terminates the remote end of the bus extension at the last I/O Station connected to the extension bus. Note that the I/O extension does not work if the bus terminator is not connected.

It is fitted to the last back-to-back connector of the bus extension cable. It is secured together with the connector to the bus extender CI610 by the long screws supplied with the cable.

The two short screws supplied with the bus terminator are needed to fix the first bus extension cable to bus extender CI615.

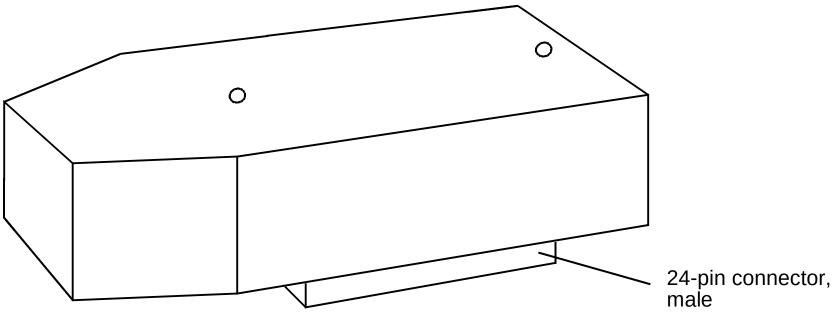


Figure 3-18. Bus Terminator TC610

3.4 CI630, CI631

3.4.1 Module Description

The Communication Interfaces CI630 and CI631 are bus couplers to Advant Fieldbus 100. Two CI630 or two CI631 can be combined as redundant Communication Interfaces.

For details please refer to the manual *Advant Fieldbus 100 User's Guide*.

The main function of the Communication Interfaces concerns service and process data exchange between Advant Controller 160 and Advant Fieldbus 100. CI630/CI631 can be bus master and time synchronization slave.

The Communication Interface CI630 is used for a coax Advant Fieldbus 100. Up to 80 stations may be connected to this kind of bus.

The Communication Interface CI631 is used for a twisted pair Advant Fieldbus 100. Up to 32 Stations may be connected to this kind of bus.

If a single Processor Module and non redundant CI630/CI631are used, the CI can act as time synchronization master on the main control bus as well as on the subordinated control bus.

Additionally CI630/CI631 is used for controller internal data management tasks. Therefore each Advant Controller 160 must contain one CI630 or CI631 at position 2.

For configurations with one Advant Fieldbus 100 the Communication Interface CI630/CI631 must be placed at position 2 (non redundant interface) or in position 1 and 2 (redundant interface) in the Basic Station.

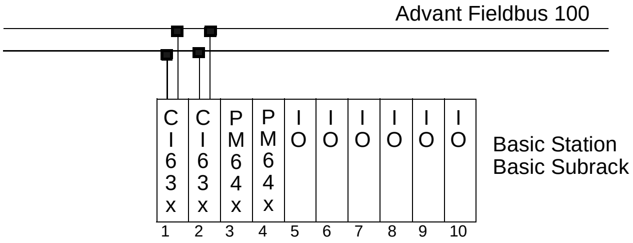


Figure 3-19. Configuration with Redundant Modules CI630 or CI631

Additionally a second Advant Fieldbus 100 can be used as subordinate control bus. If a second (subordinate) Advant Fieldbus 100 is used its Communication Interface can be placed in position 9 and 10 of the Basic Station.

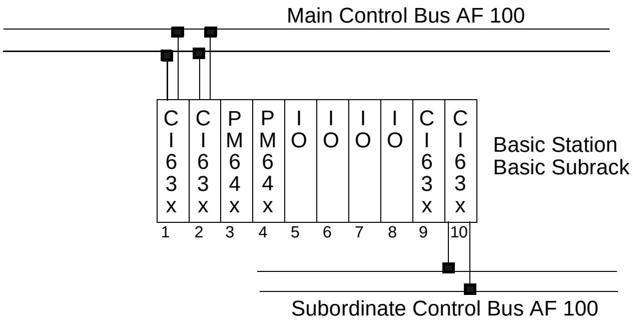


Figure 3-20. Configuration with CI630/CI631 for Dual Control Bus AF 100

The CI630/CI631 together with it’s partner CI has the ability to work as a redundant Communication Interface. One CI630/CI631 can also be used as a non redundant Communication Interface. Both CI626 and CI630 (or CI627 and CI631 for twinaxial AF 100) can coexist on the same AF 100 bus and—in case of a second AF 100—also within the same controller (see Section 3.4.11 - Section 3.4.14).

After insertion of the CI630/CI631 or power-on, the interface is in its initial (passive) state and no process data is sent or received. In that state, no bus administration functions are shared with other Communication Interfaces on the bus and no time synchronization is done.

After the Processor Module has activated the CI630/CI631 (Communication Interface is set to operation and the green LED RUN is lit) and transferred the programmed configuration, data exchange on the AF 100 takes place.

With redundant Communication Interface one CI630/CI631 is the active, the so called primary CI630/CI631. The other CI630/CI631 is the backup CI630/CI631. The backup CI630/CI631 has an updated state at all times in order to be able to take over from the primary CI630/CI631 without unnecessary delay. The presence of Communication Interfaces is transparent to all other devices on Advant Fieldbus 100.

The availability of the redundant Communication Interfaces are tested cyclically through the system software of the controller without impact on the functional behavior of the transmission (send and receive).

Module Replacement

On-line replacement possible. The Processor Modules requires at least one CI630/CI631 in position 1 or 2. The communication between other stations is unaffected. No jumpering and no adjustments required.

3.4.2 Supervision

Primary and backup CI630/CI631 perform mutual supervision.

The backup CI630/CI631 continuously receives the cyclic data sent by it’s primary partner and checks if they are sent regularly. The primary CI630/CI631 attempts periodically to address the module status word of the backup CI630/CI631. Therefore if the backup CI630/CI631 is not operational, the primary CI630/CI631 will detect this.

Reporting a problem with the partner CI630/CI631 is done through the standard diagnostics.

The Communication Interface CI630/CI631 detects errors described as follows:

- low power supply voltage
- fatal hardware errors
- fatal bus disturbances
- cyclic data not updated regularly by the Processor Module.

In case of such errors, the green LED RUN turns off and the red LED FAULT goes on.

After clearing all fatal errors, the Communication Interface is set to operational by the Processor Module.

3.4.3 Bus Master Function

Data transfer on Advant Fieldbus 100 bus is controlled by a bus master through polling of the bus nodes.

The bus master function is not associated with a specific node permanently. The function can be passed from one node to another using token passing. In this way, bus traffic is guaranteed in case of a failure of the temporary bus master, because another Communication Interface takes over the master function.

The capability to become bus master can be enabled or disabled by setting the attribute MASTER at DB element CI630/CI631.

3.4.4 Time Synchronization

The time synchronization facility enables the cyclic synchronization of the internal clocks of Advant Controller 160 stations within one Advant Fieldbus 100 system.

The TIMESYNC attribute at the CI630 (CI631) DB element defines the mode of time synchronization.

NONE: Time synchronization is disabled (sending as well as receiving) and time must be set via the Engineering Station.

MASTER: Time synchronization is enabled. Advant Controller 160 can be time synchronization master if the CI630/CI631 is used in non redundant mode and only one Processor Module is installed.

SLAVE: The station is time synchronization slave, time telegrams are received via AF 100 and the internal clock is adjusted to the internal time of the time synchronization master. The setting of time via the Engineering Station is not possible.

The time synchronization function has no effect on the bus master function.

3.4.5 Addressing the Redundant CI630, CI631

Station Address dDcoding

If the Communication Interface module is located at position (1 or) 2 in the Basic Station, the module reads the station address from the station address switch (located on the backplane of the Advant Controller 160 Basic Station). The STATION attribute of the data base element CI630/CI631 must have the same value.

If the communication module is located at position 3 to 20 of the Basic Station, the module gets the station address from the STATION attribute of the data base element CI630/CI631.

The station address must be unique and must be in the range of 1 to 79.

Addressing the Backup CI630/CI631

With redundant Communication Interfaces the backup CI630/CI631 must have another AF 100 station address than the primary CI630/CI631. Therefore the backup employs an AF 100 station address with an offset of 80 to that of the primary CI630/CI631.

Having the station address this way has some consequences. Any Communication Interface device with an AF 100 address less than 128 will be identified as a “normal” AF 100 interface, even if the address is higher than the maximum configurable 79! Such stations will therefore be invited to participate in sharing the bus master functions and the exchange of bus configuration data.

This implies that the station address of a redundant CI630/CI631 should not be larger than 47, as this would cause the address of the backup CI630/CI631 to exceed 127. It is however possible to build networks with more than 47 controllers with redundant CI630/CI631, however, the backup CI630/CI631 bus couplers with addresses > 127 would then not be invited to participate in sharing the bus master functions and the bus configuration data exchange. But this is no drawback, as the backup CI630/CI631 will be updated when it becomes the primary CI630/CI631.

If there is only one controller with redundant CI630/CI631 modules on the AF 100 bus, and there are no other AF 100 nodes with bus master capability the backup CI630/CI631 must have an address ≤ 127, that is the primary CI630/CI631 must have an address ≤ 47. Only with these addresses the backup CI630/CI631 can become bus master which is a necessary condition for the cyclic switch-over of the CI630/CI631 modules from primary to backup and vice versa. For description of the switch-over handling see Section 3.4.7, Switch-over Handling.

Addressing the Primary CI630, CI631

An Advant Controller 160 with a redundant pair of CI630/CI631 Communication Interfaces appears as a single AF 100 node on the bus. Both CI630/CI631 bus couplers employ the same bus address when they are active (primary).

Only the primary CI630/CI631 is sending DSPs on the Advant Fieldbus 100. Both the primary and the backup CI630/CI631 receive DSPs from the bus.The backup CI630/CI631 additionally receives the DSPs which are sent by the primary CI630/CI631. This guarantees that the backup CI630/CI631 has an updated state of the sending DSPs as well as it provides an important supervisory function of the primary CI630/CI631. If these DSPs are not received by the backup

CI630/CI631, there must be something wrong with the primary CI630/CI631 (or with the receiving circuits of the backup CI630/CI631). The Processor Modules only write and read the DSPs to respectively from the primary CI630/CI631.

If the primary CI630/CI631 bus coupler fails, the Processor Modules force a switch-over to the other CI630/CI631 interface. Occasionally, accessing the failed CI630/CI631 is attempted in order to detect when it is again operational.

If the backup CI630/CI631 interface fails the Processor Modules detect it and report it via the station status to the operator station. Switch-over to the failed CI630/CI631 interface is automatically blocked.

3.4.6 Configuration

Within an Advant Controller 160 station, at least one Communication Interface CI630/CI631 on position 2 is required.

At start-up of the controller, the Communication Interface CI630/CI631 reads out the adjusted node number and, if connected to Advant Fieldbus 100, adapts itself to the present Advant Fieldbus 100 configuration.

The configuration attributes are represented by the DB element CI630 or CI631, which is also described in the manual *Data Base Elements - Advant Controller 100 Series.* The following figure shows the layout of the CI630 element. The CI631 element is similar except the module type

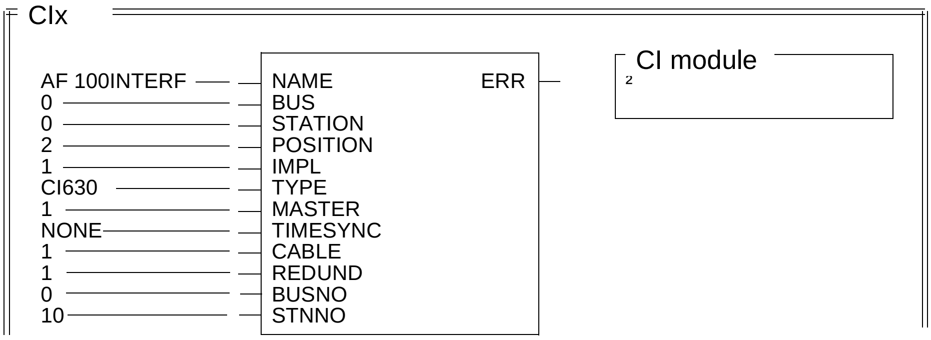


Figure 3-21. CI 630 Module Element

The attributes BUS and STATION are predefined and always set to 0.

The POSITION attribute defines the slot number of the CI630/CI631 within the Basic Station. It is set to 2 on default.

The MASTER attribute defines whether or not the Communication Interface participates in bus master functions (1 for enabled bus master functions, 0 for disabled bus master functions).

The TIMESYNC attribute defines the time synchronization mode, see section Section 3.4.4, Time Synchronization.

The CABLE attribute defines whether the optional redundant line is used. The value “1” means no redundant line is used, value “2” means a redundant line is used.

The REDUND attribute defines whether the CI630/CI631 on position “POSITION” will have a redundant partner or not.

At ERR terminal hardware errors are indicated. “0” means no error and “1” means fatal hardware error.

The attribute BUSNO is a logical addressing of the used Advant Fieldbus 100. Redundant CI630/CI631 partner must have unique bus numbers.

The attribute STNNO defines the station address of an AF 100 station. If CI630/CI631 is placed in position 1 or 2 the station address must be unique to the thumbweel address of the Basic Station.

All other attributes are not adjustable or not important for the Communication Interface.

All Processor Modules must include the CI630/CI631 in the DB configuration. For redundant CI630/CI631 two DB elements CI630/CI631 must be configured.

3.4.7 Switch-over Handling

In order to prove that both CI630 or CI631 are operational, a switch-over is cyclically forced once per hour through the system software of the controller. The forced switch-over is smooth and without impact on the DSP transfer.

The switch-over is not done when the primary CI630 is in one of the following states:

- Engaged as Bus Master.
- Engaged in Bus Configuration Management on Advant Fieldbus 100.
- Engaged in Service Data Transfer.

The CI630/CI631 ignores a request for a switch-over as long as it is within one of these states. It may take some time (several seconds) until the switch-over is possible, the procedure is as follows:

- A Processor Module (namely the service data master) requests the primary CI630/CI631 to perform a switch-over. Before initiating this, it is checked that the backup CI630/CI631 is operational.
- When the primary CI630/CI631 is ready it enters the backup state.
- After that the Processor Module immediately instructs the other CI630/CI631 to enter the primary state.

The time between disabling the primary and enabling the backup CI630/CI631’s cyclic transmission is not longer than a few milliseconds. The consequences of this will be that some DSPs may loose a transmission cycle on Advant Fieldbus 100, but as they are not timed-out until four consecutive cycles have been lost, the only consequence is that the other AF 100 nodes receive old values for a few DSPs for one bus cycle.

The backup CI630 must have an address ≤ 127, that is the primary CI630/CI631 must have an address ≤ 47. Only with these addresses the backup CI630/CI631 can become bus master which is a necessary condition for the cyclic switch-over of the CI630/CI631 modules from primary to backup and vice versa.

Upon detection of any error that would jeopardize the operation of the Advant Controller 160, the primary CI630/CI631 enters the passive state. This causes all DSP accesses to time-out on the backplane bus, and the Processor Modules will thus become aware of the situation. Through the diagnostics information, the cause of the problem can be determined.

Service Data Transfer

The service data master maintains information about which CI630/CI631 is presently the primary, as it is not possible to exchange service data on Advant Fieldbus 100 using the backup device. In case of a forced switch-over due to a CI630/CI631 failure, any ongoing service data communication will be aborted and restarted with the new primary CI630/CI631. If restarting from scratch is not possible, the communication with the originator of the service data message will be aborted, and the originator then can retry the transfer.

3.4.8 Fault Reaction

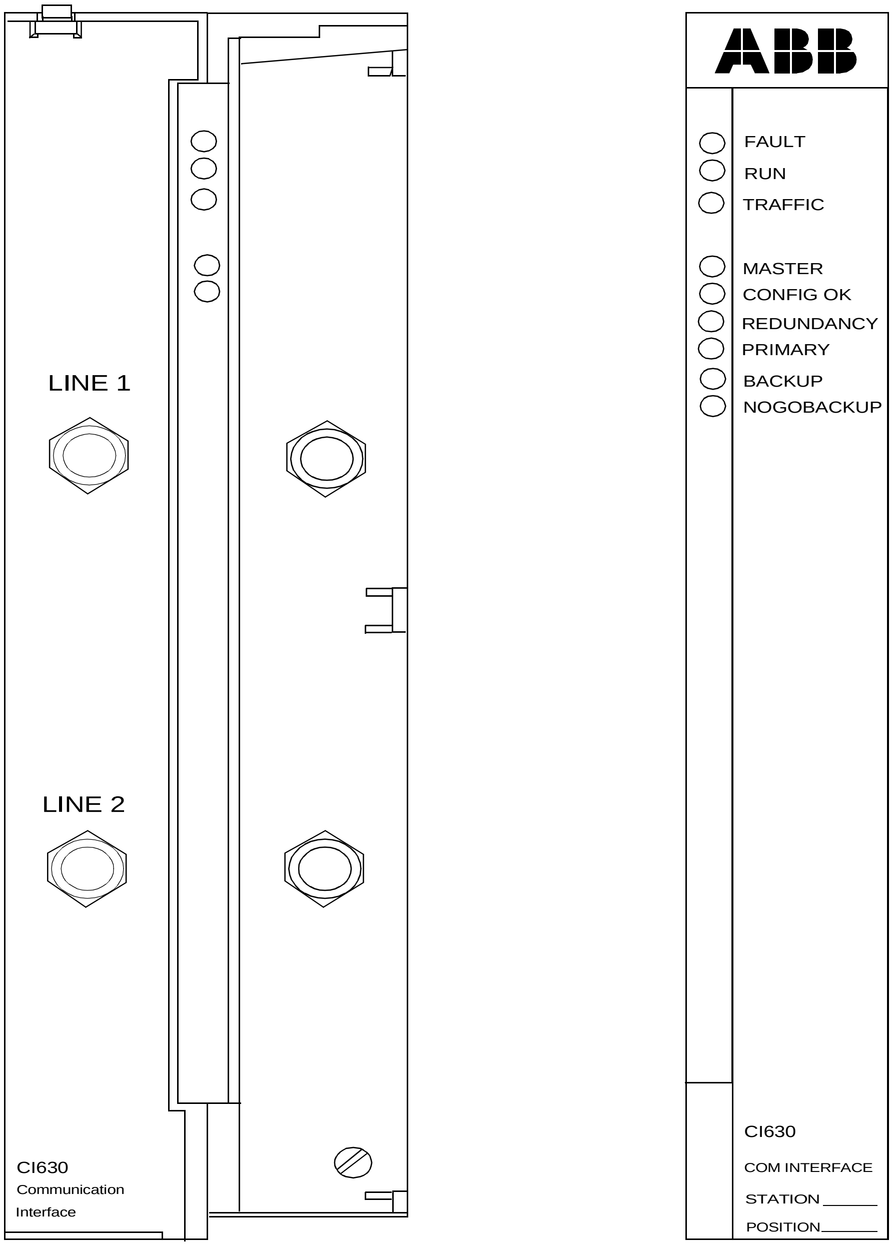
If the primary CI630/CI631 fails it enters the passive state. The Processor Module detects this and immediately instruct the back up CI630/CI631 to enter the primary state. The switch-over is bumpless because the backup CI630/CI631 has been continuously updated concerning sent and received data sets.

If the back up CI630/CI631 fails this is detected by the primary CI630/CI631 and the Processor Module. Switch-over to the back up CI630/CI631 is prevented until the backup module is repaired.

Faults are reported via standard diagnosis.

3.4.9 Module Front

Module Front of CI630



Front door open

Front door closed

Figure 3-22. CI630 with Open Front Door (left) and Front View (right)

Module Front of CI631

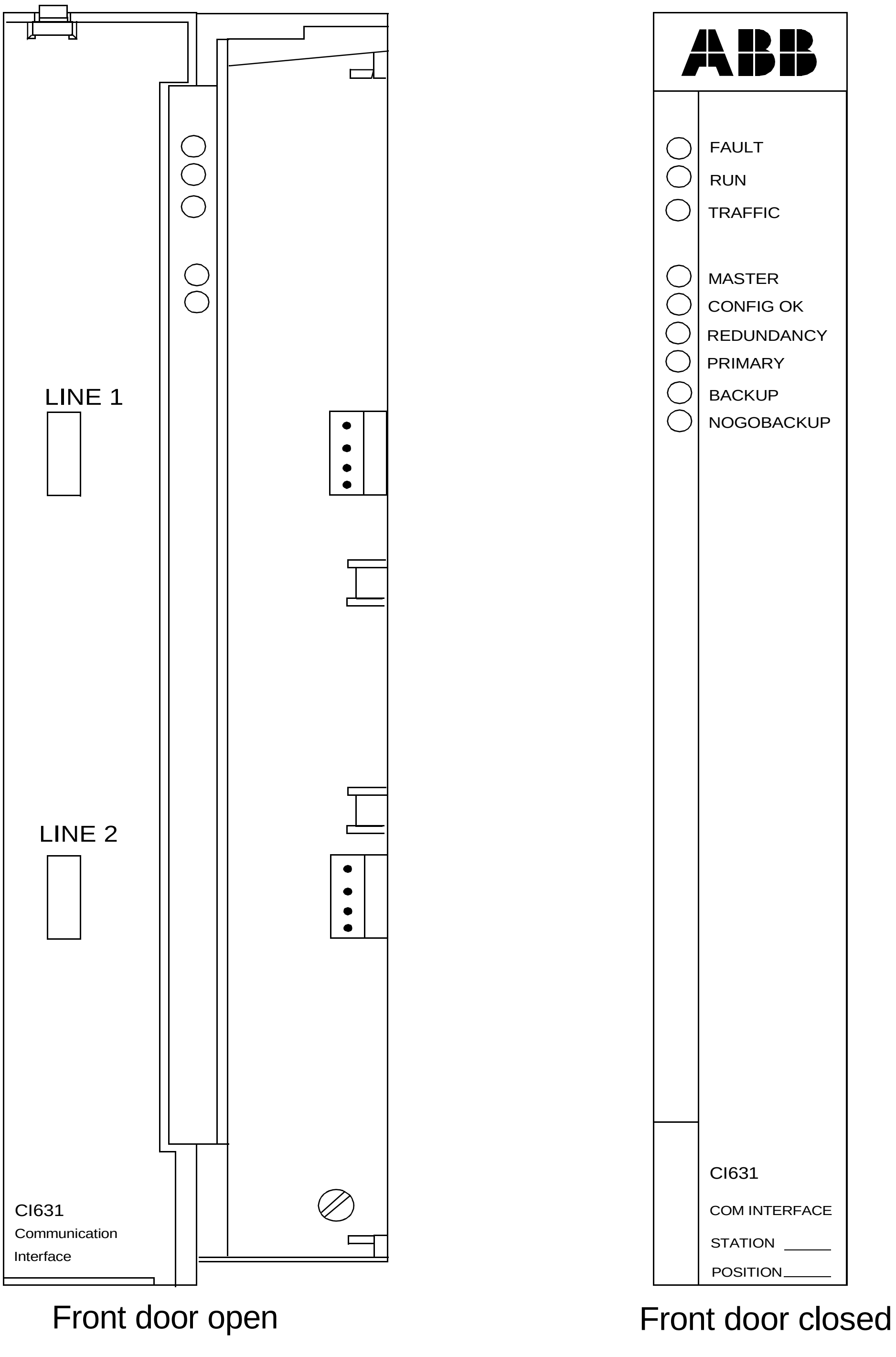


Figure 3-23. CI631 with open Front Door (left) and Front View (right)

Connections of Twisted Pair Advant Fieldbus 100

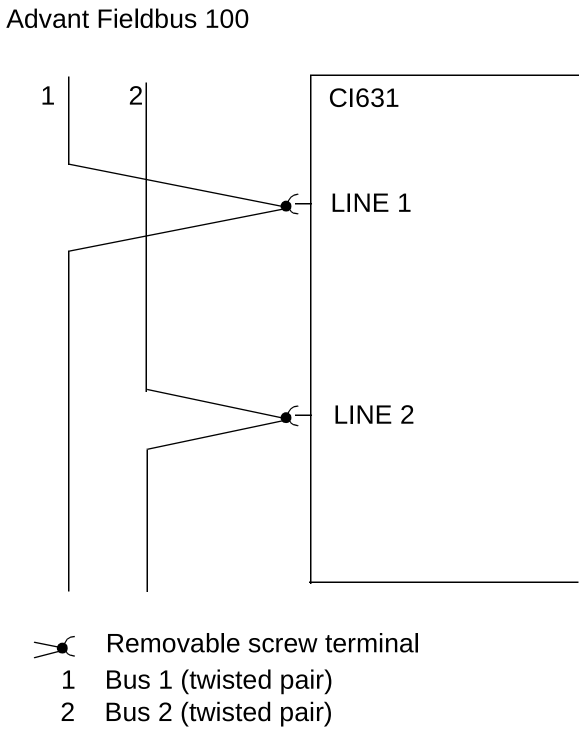


Figure 3-24. CI631 Connections to Advant Fieldbus 100

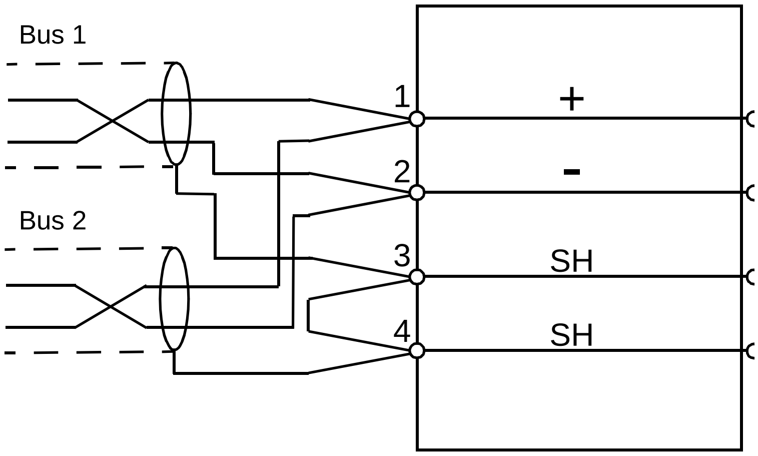


Figure 3-25. Details of Connecting the Removable Screw Terminal

The meaning of the LEDs is shown in the Table 3-19.

Table 3-19. CI630, CI631 Front LEDs

LED	Indicates
FAULT	The Communication Interface has detected a fatal hardware error and stopped communication via Advant Fieldbus 100. In this case, the meaning of all other LEDs are different from the following descriptions—they are then used for diagnostic purposes.
RUN	The Communication Interface is fully configured and operational.
TRAFFIC	If bus master: The LED indicates that the CI630/CI631 got an answer from another station on the bus. If not bus master: The LED indicates that the CI630/CI631 had been addressed by another station.
MASTER	This LED is on when the CI630/CI631 acts as bus master on the AF 100. This LED will be on at exactly one CI630/CI631 at a time in the network due to rotating bus master responsibility.
CONFIG OK	This LED indicates that the CI630/CI631 has the same perception of the data set configuration as the (current) master Communication Interface. It will therefore participate in the sharing of the master responsibilities if the MASTER function is enabled and the module is operational and synchronized.
REDUNDANCY	This LED is on when CI630/CI631 is configured as redundant.
PRIMARY	This LED indicates that the module is currently primary.
BACKUP	This LED indicates that the module is currently backup.
NOGOBACKUP	This LED is on when a primary module can not forced to go backup by the Processor Module.

3.4.10 Technical Data

Table 3-20. CI630 Technical Data

Communication Interface	**CI630**	**CI631**
Communication connection	Coaxial bus	Twisted pair bus.
Connector type	BNC 75 Ω, jack	Removable screw terminal.
Cable type	75 Ω	Twisted pair. Specification according to *Advant Fieldbus 100 User's Guide*.
Power dissipation		
• max.	11 W	11 W
Cable number	TK518 (single cable) TK516 (redundant cable)	–

3.4.11 CI630 and CI626 in the same Network

For non redundant Advant Fieldbus 100 coax interface both CI630 and CI626 can also be used for Advant Controller 160. Using both Communication Interfaces in one Advant Fieldbus 100 network is possible as well.

3.4.12 CI630 and CI626 in the same Controller

For each Advant Fieldbus 100 interface only one Communication Interface type is allowed: CI630 or CI626. Consider that only CI630 can be used redundantly.

If two Control Buses Advant Fieldbus 100 are to be connected to the controller each Advant Fieldbus 100 interface can be realized with different Communication Interface types, for example two redundant CI630 for the main Advant Fieldbus 100 and one (non redundant) CI626 for the second Advant Fieldbus 100.

3.4.13 CI631 and CI627 in the same Network

For non redundant Advant Fieldbus 100 twisted pair bus interface both CI631 and CI627 can be used for Advant Controller 160. Using both Communication Interfaces in one Advant Fieldbus 100 network is possible as well.

3.4.14 CI631 and CI627 in the Same Controller

For each Advant Fieldbus 100 interface only one Communication Interface type is allowed: CI631 or CI627. Consider that only CI631 can be used redundantly.

If two Control Buses Advant Fieldbus 100 are to be connected to the controller each Advant Fieldbus 100 interface can be realized with different Communication Interface types, for example two redundant CI631 for the main Advant Fieldbus 100 and one (non redundant) CI627 for the second Advant Fieldbus 100.

3.5 DI685

3.5.1 Summary

The digital input module DI685 converts the binary signals from the sensors to the internal signal levels required by the internal programmable controller. It has 32 digital input channels selectable for 24 V/48 V applications organized in 4 groups of 8 and can be used in two different modes:

- Normal digital input
- Digital input with sequence of event recording (SOE)

In addition it provides the following features for both operation modes:

- Channel supervision function to detect wire break/short circuit per channel within 48 V sensors
- Internal 48 V d.c. sensor power supply
- Configurable shutter filter
- Adjustable bounce filter
- External 48 V d.c. sensor power supply
- Sensor power supply voltage supervision
- Input status indicators
- EMC protection

Associated Data Base Elements

Associated data base elements are DI685 for the module and DIS685 for its input channels.

Module Replacement

On-line replacement is possible. No jumpering and no adjustments required.

3.5.2 Technical Data

Table 3-21. DI685 Technical Data

Digital input	DI685
No. of inputs	32
Input voltage • Rated voltage UP • Input voltage range for logical “0” • Input voltage range for logical “1”	 48 V d.c. / 24 V d.c. -30 V to +5 V +11.2 V to +36 V (UP = 24 V) +30 V to +60 V (UP = 48 V)
Nominal input current • with 24 V • with 48 V	 1.6 mA 3.2 mA
Time delay typical (1)	Selectable 0 to 256 ms.
Operating modes	SOE recording digital input.
Sensor type	48 V contact input, 24 V electronic input.
Shutter filter in event-recording mode • Recovery time • Shutter-triggering • Shutter period	 0 to 65,000 s 0 to 256 changes 0 to 256 s
Max. cable length	1000 m
Isolation • Test voltage	Yes, opto, in groups per 8. 500 V_{rms}
Monitoring inputs for UP1–4	4
Current consumption • typical (2) • max. (3)	 242 mA 308 mA
Power dissipation • typical (4) • max. (5)	 11.6 W 14.8 W
Weight	1.1 kg

(1) For event-recording mode, 0–32 ms. If bounce filter is turned off, use screened cable.
(2) Typical consumption from electronic power supply USA/USB with 70 percent of the channels activated and internal 48 V sensor power supply.
(3) Maximum consumption from electronic power supply USA/USB at maximum supply voltage within internal sensor power supply and all inputs activated.

(4) Total power dissipation at rated supply voltage, with 70 percent of the channels activated and internal 48 V sensor power supply.

(5) Total power dissipation at maximum supply voltage and all inputs activated.

3.5.3 Front View

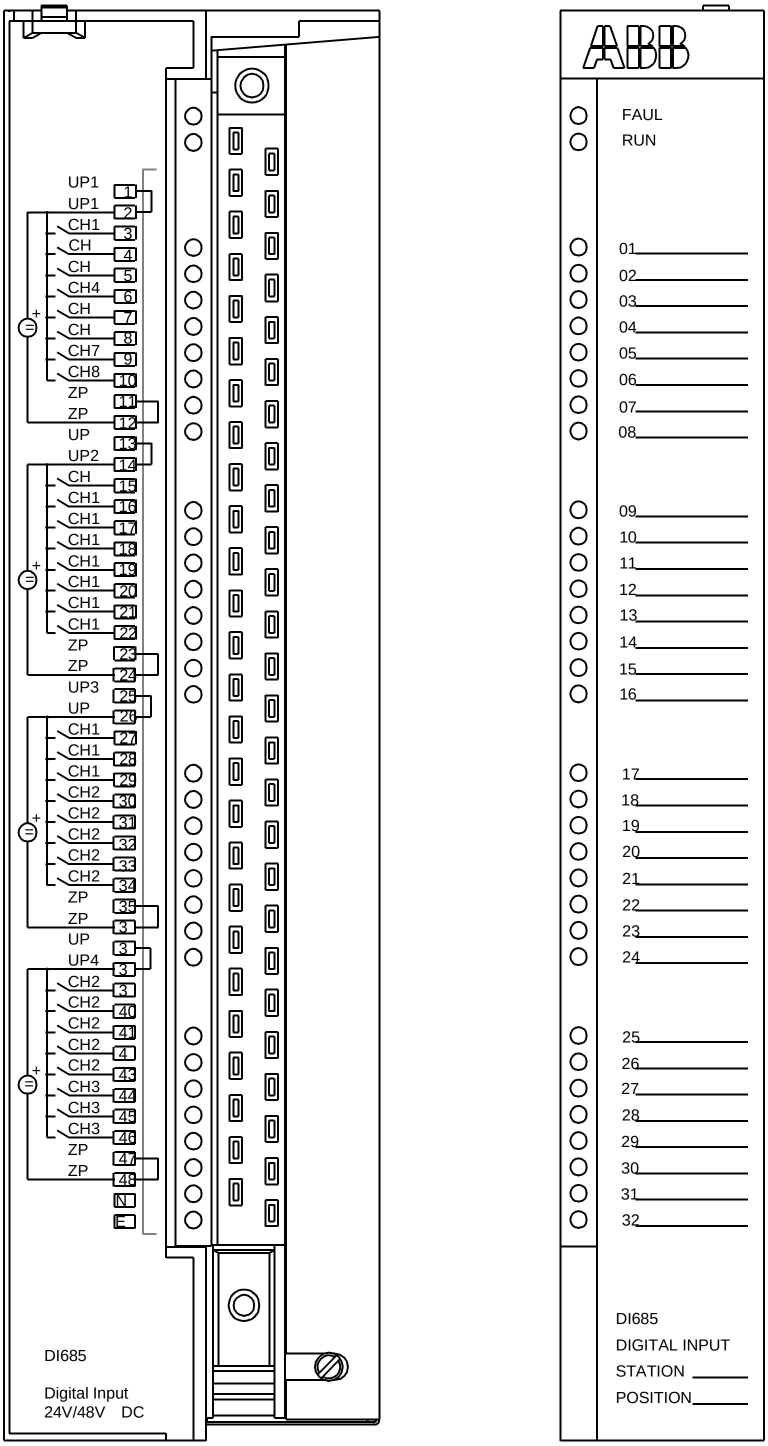


Figure 3-26. DI685 Front View

3.5.4 Process Connections

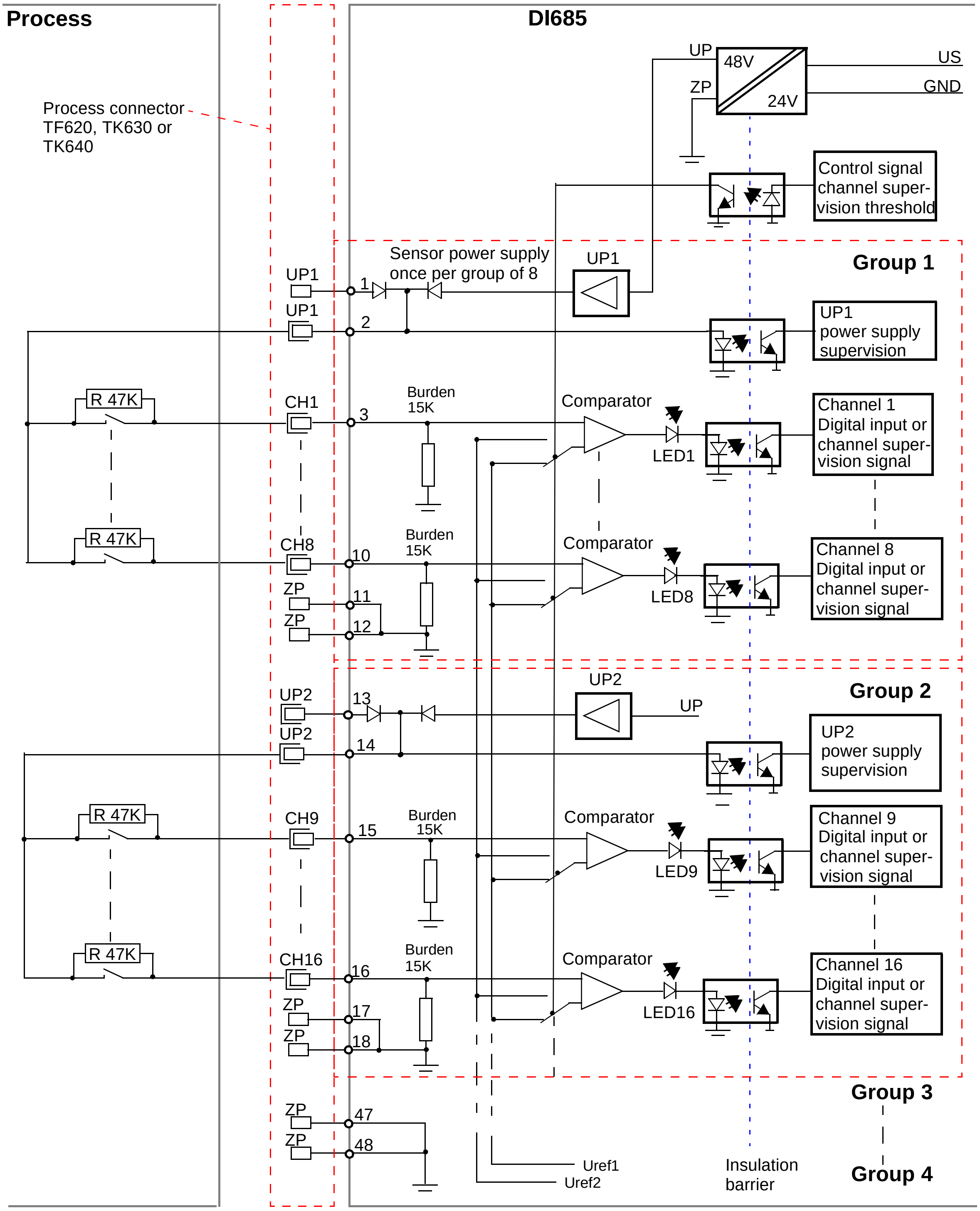

Process
DI685
Process connector TF620, TK630 or TK640
UP
ZP
48V
24V
US
GND
Control signal channel supervision threshold
Sensor power supply once per group of 8
UP1
Group 1
UP1
UP1
1
2
UP1 power supply supervision
R 47K
CH1
3
Burden 15K
Comparator
LED1
Channel 1 Digital input or channel supervision signal
R 47K
CH8
10
Burden 15K
Comparator
LED8
Channel 8 Digital input or channel supervision signal
ZP
11
ZP
12
UP2
Group 2
UP2
13
UP
UP2
14
UP2 power supply supervision
R 47K
CH9
15
Burden 15K
Comparator
LED9
Channel 9 Digital input or channel supervision signal
R 47K
CH16
16
Burden 15K
Comparator
LED16
Channel 16 Digital input or channel supervision signal
ZP
17
ZP
18
Group 3
ZP
47
ZP
48
Uref1
Uref2
Insulation barrier
Group 4

Figure 3-27. DI685 Process Connections and Internal 48 V Sensor Power Supply

3.5.5 Functional Description

The DI685 is a configurable 32 channel digital input module with additional functions to support a wide range of different applications.

It can be configured as normal digital input module or digital input module with sequence of event (SOE) recording functionality. In both modes a channel supervision, internal 48 V sensor power supply, sensor power supply voltage monitoring and the support of 24 V/48 V sensor types is available.
The input signals of the input module DI685 can be filtered to suppress any electrical interference or contact bounce.The filter time is adjustable from 0 to 255 ms in powers of two. This means that noise pulses shorter than the filter time will be filtered out and pulses longer than specified will get through the filter.

Configuration is done on the DI685 module DB element and DIS685 signal DB element. After start up the Advant Controller 160 software checks if the module is installed correctly, loads the configuration and switches the module into the operating mode (“RUN”). If a severe fault is detected, the mode changes to “ERROR” state.

Communication

An application program consisting of PC and DB elements runs cyclically in Advant Controller 160. Before the execution of a program module (e.g., control module), the Processor Module reads the input register of the input module via the backplane bus.

The cycle time of the control module determines the periodicity by which the signals are read. All inputs are scanned and the data base elements updated, whether the input values have changed or not.

For this reason, the update rate depends on the cycle time of the corresponding control module programmed on the Processor Module.

Signalization

Two LEDs on the front of the module indicate the module status. A green LED (RUN) indicates that the module is operating normally. A red LED (FAULT) signals a severe fault.

In accordance to the actual channel configuration the channel status is indicated by 32 yellow LEDs on the front of the module.

Within active channel supervision the LED-state “ON” indicates an existing wire-connection to a powered 48 V contact of the corresponding channel and the LED-state “OFF” displays the error state of this channel.

Without active channel supervision the LED displays the actual value “1” (LED ON) or “0” (LED OFF) of the corresponding channel.

Characteristics of Input Channels

Every input channel consists of current limiting components, EMC protection components, input state indication LED and optical isolation barrier to isolate the inputs of the DI685 from the system potential. The 32 digital inputs are arranged in 4 groups of 8 channels with a common return (ZP).There is no galvanically isolation between the groups.

General Operating Modes

- Event recording

The input module DI685 can be used for event recording (SOE), i.e., changing signals at digital input channels can be announced together with a time stamp indicating when it occurred. The time stamp has a resolution of 1 millisecond.

The module has intermediate storage for 64 events.

The SOE functionality can be switched on and off per channel.

For all channels with enabled SOE capability, a shutter filter is implemented that prevents intermediate storage for events from overflow. The shutter filter is closed as soon as the number of events generated within the shutter period exceeds the shutter trigger number (0–255 seconds). The shutter filter remains closed as long as the recovery time (0–65,000 seconds) has not expired.

- Simple digital input

If no event recording is used, the DI685 acts like a simple digital input device.

Selectable Features

- Channel supervision

  The DI685 is able to supervise the process channel regarding wire break of sensor cable, missing sensor and short circuit of sensor voltage to module ground.

  The supervision can be switched on and off per group of 8 channels independent from the operating mode.

  The channel supervision is only possible for 48 V contacts equipped with a parallel resistor of 47 kΩ ±2%.

- Sensor power supply and supervision

  The DI685 provides an internal 48 V d.c. sensor power supply per group of 8 channels. It is short-circuit proof per group of 8 channels and galvanically insulated from the 5 V circuit. There is no galvanically insulation between the groups but electrical isolation. The internal sensor power supply can be switched on and off per device.

  It is also possible to supply the sensors with an external 48 V d.c. power supply. In this case the internal sensor power supply has to be switched off.

  For each of the four groups of 8 channels the sensor supply voltage is monitored. The UP supervision responds if one of the process voltages is too low, which is indicated by the data base element. The supervision is provided for internal and external sensor supply voltage. It can be switched on and off per group of 8 channels.

Supported Sensor Types

The following sensor types are supported by the DI685:

- Dry contacts supervised: 48 V d.c. / 3.2 mA. The supervision is only possible for contacts with resistor connected in parallel. Supervision is always available within internal sensor power supply. Supervision in connection with external sensor power supply requires the same strict limits in the tolerances of the external supply voltage as for internal supply voltage (48 V d.c. ±10%)

Two way switch contacts can be connected to the input module with use of two input channels each providing one binary signal. Non-equivalence supervision must be configured with use of PC elements of execution within the application program.

- Dry contacts not supervised with external power supply: ≤ 60 V d.c. / max. 4 mA
  The maximum input voltage of 60 V d.c. must be kept strictly.

  Two way switch contacts can be connected to the input module with use of two input channels each providing one binary signal. Non-equivalence supervision must be configured with use of PC elements of execution within the application program.
- Electronic inputs not supervised: 24 V d.c. / 1.6 mA
  Only in combination with external power supply.
- Open collector drivers not supervised: 24 V d.c. / 1.6 mA
  Only in combination with external power supply.

On the DI685 it is possible to mix up 48 V d.c. and 24 V d.c. sensor types in two groups of 16 channels. Therefore two sensor type terminals (SENSTYP1 / SENSTYP2) are available to configure group 1/2 and group 3/4 separately as inputs for 48 V d.c. or 24 V d.c. sensor types.

3.6 DP640

3.6.1 Signal Processing

The speedometer module DP640 provides two input channels for speed measurement.

The measurement of the main speed channel is characterized by a high sampling rate (sample interval 5 ms), sufficient measurement time for high accuracy (for example 20 ms) and a high resolution (14 bits). The frequency range of the input pulse signal is up to 50 kHz.

Various types of sensors with different types of output signals may be connected to dedicated input pins of the speed measurement channels. It accepts for example the following tach signals: 24 V analog (for example eddy probe), 5 V TTL, 5 V differential (RS485).

All inputs and outputs are galvanically insulated from the BIOB backplane supply via opto couplers. The two channels are not insulated from each other.

The device provides a supervised power supply with different voltages for different types of sensors.

The device features a configurable supervision of the main speed sensor and the sensor cabling.

An overspeed signal (trip signal) is generated by the device at a dedicated, fail safe output in case of an overspeed situation at the main channel or in case of faults. The function of the overspeed supervision can be tested via MMI or Engineering Station.

A Ready for Operation signal is generated at a dedicated output if the device and the main sensor were found to be in operating conditions.

A Standstill signal is generated at a dedicated output if the main speed is lower than a configured limit.

The second input for the second speed signal may be used for the detection of the direction of the main wheel’s rotation or for measurement of the speed of a second wheel. It provides a reduced supervision functionality.

In addition the module provides a peak hold mechanism.

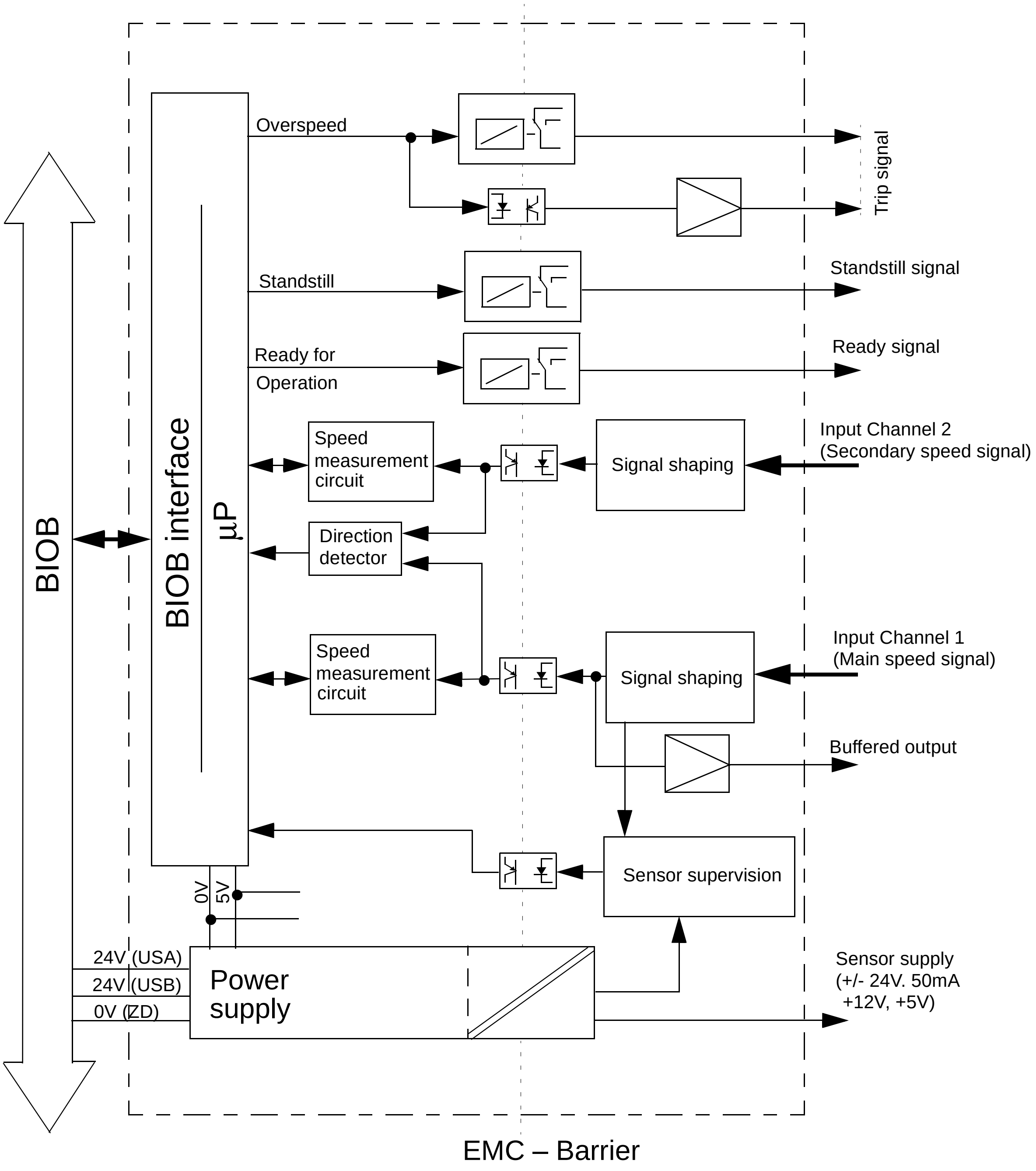


Figure 3-28. DP640 Block Diagram

3.6.2 Operation Modes

Table 3-22. Operating Modes of DP640

Operating mode	Function
High Precision “ON”	Speed measurement is done over one revolution of the tooth wheel (“accurate”)
High Precision “OFF”	Speed measurement is done over the specified measurement interval (“fast”)

A tach sensor produces a pulse train signal corresponding to the passing teeth. The module accepts the tach signal at the appropriate inputs, conditions the signal in special conditioning circuits (for example strips DC components) and produces a clean tach signal. This signal is a) forwarded to the measurement circuit and b) put out via a buffer as differential RS422 signal.

The measurement of the frequency of the pulse train at the speed input follows the principle of ratiometric measurement, which is a pulse length measurement over a sequence of several pulses. During an automatically chosen integer multiple of signal periods of the speed signal a reference counter counts the pulses of a high frequency reference oscillator.

High Precision ON

The amount of measured speed signal pulses is determined by the amount of teeth of the wheel (for example 60 teeth). Thus the duration of one whole revolution period (for example 20 ms) of the gear wheel is measured. This method of measurement ensures high accuracy. To limit the measurement time at lower rotation speeds of the turbine, this mechanism of measurement is automatically changed at lower speeds:

The measurement time is automatically reduced to match as far as possible the duration of one revolution measured at nominal speed.

High Precision OFF (this is the high speed mode)

If configured in the mode “High Precision OFF” the measurement is done over the time span determined by DB element terminal MEAS_PER. This mode allows fast measurements down to 1 ms.

In both cases, at very low speeds the reference counter will count the reference pulses during only one full period of the tach signal (that is rising edge to rising edge). The measurement mechanism runs continuously to ensure a short measurement dead time. Every 5 ms new speed values are calculated and are written into the device's communication memory for BIOB accesses. One has to be aware of the fact that the measurement result is the mean speed value during the measurement period.

3.6.3 Peak Hold

Both channels of the device provide a peak hold mechanism.

The highest speed value which was measured since the last reset is stored in the RAM and can be read via the MMI (DB element terminal MAX_VAL). The value can be reset to 0 via the Operator Station (DB element terminal RES_MAX).

3.6.4 Direction of Rotation Measurement

The information from both input channels is used for detection of the direction of rotation.

At the rising edge of the signal of channel 1 the state (high or low) of the signal of channel 2 is latched. This state is readable at terminal RISECOMP.

3.6.5 Diagnostic Output Signals

Ready for Operation Signal, ERR Signal

These signals summarize the diagnosis about the sensor, the board and the system (see Figure 3-29). If all of these components were found to be in normal operating condition the Ready for Operation signal is set to “1” (terminal READYOP), the ERR signal is set to “0” (terminal ERR). In case of Ready for Operation the relay is activated (10–11 open, 11–12 closed at front connector).

Trip Signal

This signal is issued if the speed is too high (VALUE>H2 = 1) or when the device is not ready (READYOP = 0, ERR = 1). The trip relay is deactivated in these cases (2–3 closed, 3–4 open at front connector).

3.6.6 Filtering/Gradient Supervision

The **speed gradient** is monitored to filter possible measurement faults caused by transient disturbances (EMI). The wrong speed values will be discarded and not put out to the BIOB. If the disturbance lasts too long (that is more than five measurement periods) a sensor fault is assumed. The trip signal will be issued at the trip signal outputs (relay, transistor, see Figure 3-29) and an error will be reported to the controller via the BIOB. As soon as the gradient is permissible again the trip signal will disappear.

The maximum allowable speed gradient %/s is defined by the configuration parameter MAX_GRAD (see Data Base element Section 3.6.11, Configuration).

Missing pulses (signal cable break): Case: After a valid speed measurement no pulses arrive any more. After 5 consecutive periods without new pulses the device issues the trip signal.

After 30 seconds without new pulses the device puts out the speed value 0 and resets the trip signal.

3.6.7 General Supervision/Diagnosis

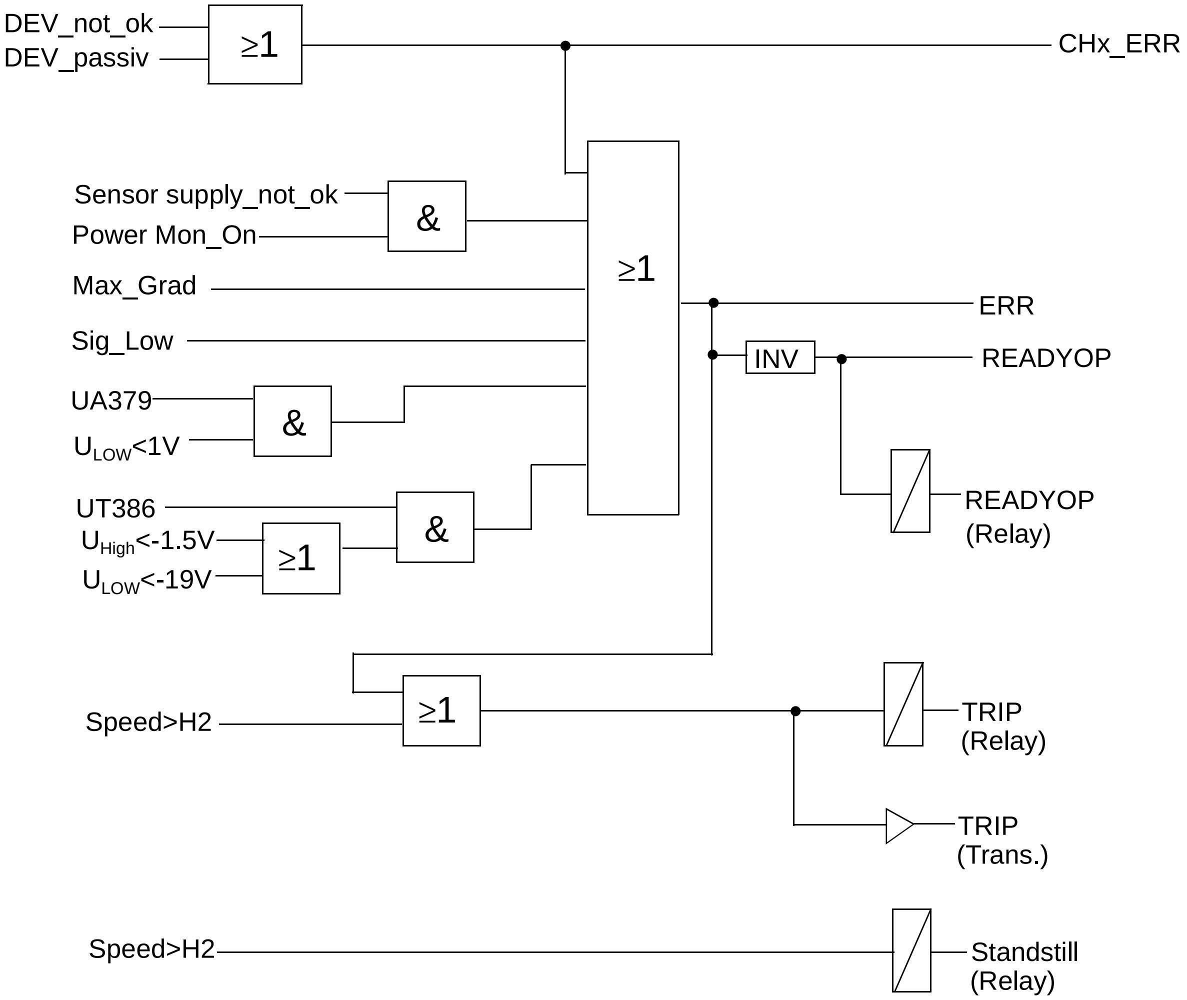


Figure 3-29. DP640 Diagnosis

3.6.8 Speed Supervision/Trip Signal

Both channels feature a limits supervision: LO_LIM2, LO_LIM1, HI_LIM1, HI_LIM2.

At channel 1 two relays are coupled with the limit bits.

Overspeed Monitor

The overspeed monitor compares the measured speed value with the limit value HI_LIM2 (for example 110%).

In case of overspeed at channel 1, that is an exceeding measured value, the overspeed signal is put out by a fast transistor output (pins 7–8, value: “0”, that is high impedance to 24 V) and by deactivation of the trip relay (2–3 closed, 3–4 open at front connector). At a normal-speed condition and normal system operation (sensor, module, Processor Module are working) the relay is activated.

In addition the overspeed monitor status is signaled via the BIOB to the Processor Module (DB terminal VALUE>H2).

Delay of trip signal (at BIOB; at transistor output): Depends on the actual measurement period. At constant acceleration the delay is this period divided by 2. (Example: nominal speed 3000 rpm equivalent 50 Hz, HIGHPREC = 1 (on); H2 = 110%; meas. period at 110%: 18 ms, delay: max. 10 ms).

The overspeed monitor at channel 1 can be tested by setting a test bit (via the engineering station, terminal ORD_VAL). This signal will cause an addition of a configurable value (terminal DELTAVAL, for example 20%) to the measured value. This increased test value will be forwarded only to the overspeed monitoring path and will trigger the overspeed monitor (bits VALUE>H2 and VALUE>H1) and the trip relay’s output. The real measured speed value forwarded to the Processor Module will remain unchanged.

High, Low Limits

Two other configurable speed limit values are monitored at both channels: LO_LIM1, HI_LIM1. The status of monitoring is transferred via the BIOB to the Processor Module (terminals VALUE<L1, VALUE>H1).

Standstill Limit

Monitoring is performed to detect a standstill condition of the turbine. A standstill condition is detected if the speed is lower than the LO_LIM2 limit speed (for example 10^{-4}%).

The corresponding status is signaled via the BIOB to the Processor Module via terminal VALUE<L2.

At channel 1, at standstill, the standstill relay is activated (14–15 open, 15–16 closed at front connector).

3.6.9 Monitoring of the Input Signal Quality

1. **Signal voltage monitor**

   At signal voltages smaller than the limits given below a sensor / cabling fault is assumed (Date Base element terminal ERR = “1”, trip).

   The minimal (differential) signal peak-to-peak values at the inputs are:

24 V analog inputs (“24V_H.I.”):	1 V_{pp} ±5%
5 V_TTL (medium impedance) input:	0.66 V_{pp} ±5%
RS485 (low impedance, diff.) inputs:	0.33 V_{pp} ±5%

2. **Live zero supervision**

   This supervision is used with transducers like the UT386 which produce a “live zero” signal (DB - pin MONTYPE: “UA379”) in case of detected errors. If the “low”-level of the input voltage at the DP640 is lower than a minimum level an error is assumed (terminal ERR = “1”, trip).

   The minimum levels are:

at high impedance inputs:	+1 V ±5%
at medium impedance inputs:	+0.66 V ±5%
at low impedance inputs:	not usable

3. **Eddy current probe too far from wheel**

   This supervision is used with eddy current probes for distance measurement (terminal MONTYPE: “UT386”). If the “low”-level of the input voltage at the DP640 is lower than a minimum level an error is reported.

   The minimum level is:

at high impedance inputs:	-19 V ±5%

4. **Eddy current probe too close to wheel**

   This supervision is used with eddy current probes (terminal MONTYPE: “UT386”). If the “high”-level of the input voltage at the DP640 is higher than a maximum level an error is reported.

   The maximum level is:

at high impedance inputs:	-1.5 V ±5%

3.6.10 Electrical Characteristics

Inputs

Different types of sensor signals may be connected to dedicated input pins of the module (for pin names see Figure 3-35).The inputs are galvanically insulated from the system, however not from each other.

1. **“24V_H.I.”: Universal high impedance input**

   This universal input is intended for 24 V sources, sources with other “high signal” voltages (for example -24 V) or sources with high output impedances.

   The sensor's signal lines can be connected as follows (see Figure 3-35):

   – Two differential inputs for increased EMI suppression: pin 24 V_H.I., for the signal line, and AC_RET, for the signal “return” line (4 wire sensors);

   – Single ended: to the inputs 24 V_H.I. and ZP.

The common mode voltage of the differential inputs is ±35 V.
The input impedance to ZP is typical 15 kΩ. The differential input impedance is > 15 kΩ.

The input features an auto-threshold mechanism: The threshold of the pulse detector follows the signals DC-value with a time constant of 2 s. The hysteresis of the pulse detector is 0.8 V.

The minimal signal amplitude is $1V_{pp}$, however higher amplitudes are recommended (EMI). Frequency range: 0.03 Hz to 40 kHz. At lower frequencies than 0.03 Hz (that is 30 seconds between pulses) the measured value changes to 0%.

2. **"5V_TTL": Medium impedance input**

   This single ended input to ZP is intended for medium impedance sources with up to 24 V. The input impedance to ZP is > 3 kΩ.

   The input features an auto threshold mechanism: The threshold of the pulse detector follows the signals DC-value. The hysteresis of the detector is 0.6 V.

   The minimal signal amplitude is $0.66\ V_{pp}$. Frequency range: 0.03 Hz to 40 kHz. At lower frequencies than 0.03 Hz the measured value changes to 0%.

3. **"5V+diff", "5V-diff": Low impedance, differential inputs**

   These inputs feature RS485 line terminations. The minimum differential voltage is 1 V.

   Frequency range: 0.03 Hz to 40 kHz. At lower frequencies than 0.03 Hz the measured value changes to 0%.

Power Supply Outputs

(pins 30, 32, 34, 36, 38)

The device features power supplies for the different types of sensors at dedicated output pins.
The following voltages are available: +24 V, +12 V, +5 V, -24 V.
The outputs are overload protected with a current limitation at 50 mA.
The outputs are short-circuit proof to +35 V and 0 V.
The power supplies are galvanically insulated from the system (500 V a.c. test voltage).
They are open-circuit and overload monitored for supervision of the sensor cabling.

Open-circuit supervision: The output current at the individual pins is monitored. If at any of the pins the output current is higher than 5 mA an "ok" is generated.

Overload supervision: The output current is monitored at the individual pins. If at any of the pins the output current is higher than 50 mA an error is reported (ERR = "1", trip).

The supervision can be switched off by an appropriate configuration (see Data Base element Section 3.6.11, Configuration).

Buffered Output for the Main Speed Signal

(pins 18, 19, 20)

The reshaped main speed signal (max. pulse frequency 50 kHz; that is min. period 20 ms) is put out by a 5 V/50 mA line driver output stage (push-pull). The output is short-circuit and overload proof:

The output current is limited to 60 mA.

The output is short-circuit proof to + 35 V and 0 V.

The output is galvanically insulated from the system (500 V a.c. test voltage) but galvanically connected to the speed inputs.

Transistor Output for the Trip Signal

See Figure 3-28 Speedometer.

In addition to the trip relay contacts the trip signal is put out by a transistor output.

This output is a transistor switch to +24 V. It is galvanically connected to the speed inputs, however galvanically insulated from the system (500 V a.c. test voltage). The maximum nominal output current is 100 mA. The output is overload protected and short-circuit proof to +35 V and 0 V (current limitation 120 mA). The output current is provided by the internal power supply of the module.

States of the switch:

“Trip”: Switch open, that is high impedance to 24 V.
“Ok”: Switch closed, 24 V output voltage.

Relays Contact Outputs

Mechanical life: min. 3 × 106 cycles
Electrical life: min. 3.5 × 105 cycles

Isolation: contact to contact: test voltage 1000 V a.c.
contact to coil: test voltage 1000 V a.c.

Breaking capability: 24 V 1.1 A d.c.
60 V 0.5 A d.c.
30 V 1.0 A a.c.

3.6.11 Configuration

It is only allowed to configure the speedometer module DP640 in one Processor Module in each station or in the two redundant Processor Modules. If the DP640 is configured in more than one Processor Module, the DP640 will be reconfigured periodically and the trip relays will be activated cyclically.

Configuration of the DP640 see DB elements below; there is one complete set of DB element parts per channel.

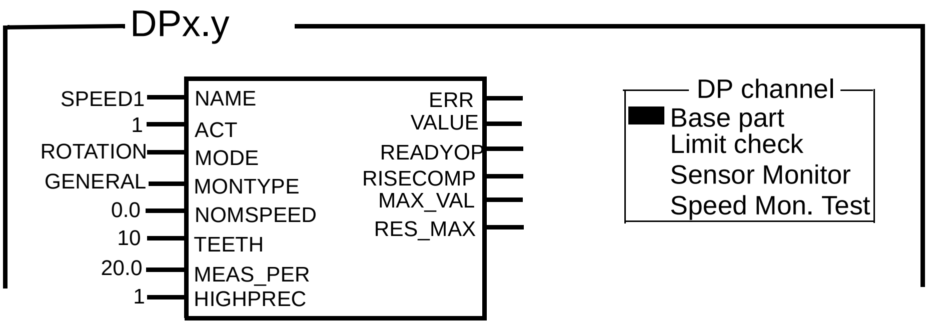


Figure 3-30. Data Base Element DP640, Base Part

The following parameters must be defined:

NAME <NAME>
Name of the channel.

ACT <channel ACTive>
This parameter determines whether the channel is used or not.
Range: 1/0 (on/off)
Default: 1

MONTYPE <MONitoring type>
This parameter determines which kind of signal monitoring will be performed.
Range: GENERAL only signal amplitude is supervised
UA379 signal amplitude and live-zero is supervised
UT386 signal amplitude and sensor distance is supervised
Default: GENERAL

NOMSPEED <NOMinal SPEED>
This parameter determines the nominal speed (100%) of the wheel; unit: rpm. The measured value is referenced to this speed as percent value.
Range: 1 to 10,000 (rpm)
Default: 0 (rpm)

TEETH
This parameter determines the amount of teeth on the wheel.
Range: 1 to 255
Default: 10

MEAS_PER <MEASurement PERiod>
This parameter determines the measurement period in operation mode “High Precision OFF”.
Range: 1 to 100 (ms)
Default: 20.0 (ms)

HIGHPREC <HIGH PRECision>
This parameter determines which mode of measurement is used.
Range: 1 (on) measurement is done over one revolution
0 (off) measurement is done over a period given by "MEAS_PER"
Default: 1 (on)

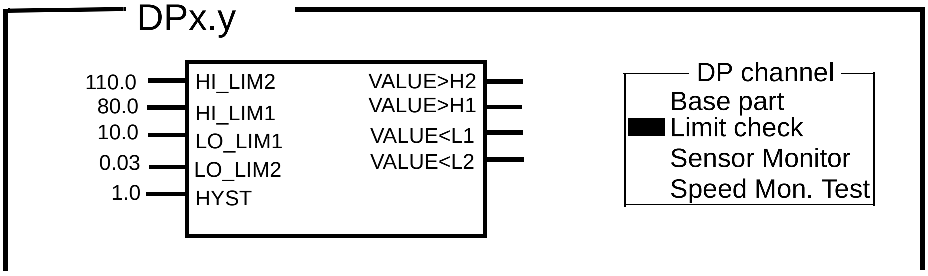


Figure 3-31. Data Base Element DP640, Limit check

HI_LIM2 <HIGH LIMit 2>
This parameter determines the overspeed limit at channel 1, and the usual H2 limit at channel 2.
Range: 0 to 200 (%)
Default: 110.0 (%)

HI_LIM1 <HIGH LIMit 1>
This parameter determines the usual H1 limit.
Range: 0 to 200 (%)
Default: 80.0 (%)

LO_LIM1 <LOW LIMit 1>
This parameter determines the usual L1 limit.
Range: 0 to 200 (%)
Default: 10.0 (%)

LO_LIM2 <LOW LIMit 2>
This parameter determines at channel 1 the standstill limit, at channel 2 the normal L2 limit.
Range: 0 to 200 (%)
Default: 0.03 (%)

HYST <HYSTeresis> for limit check
Range: 0 to 20 (%)
Default: 1.0 (%)

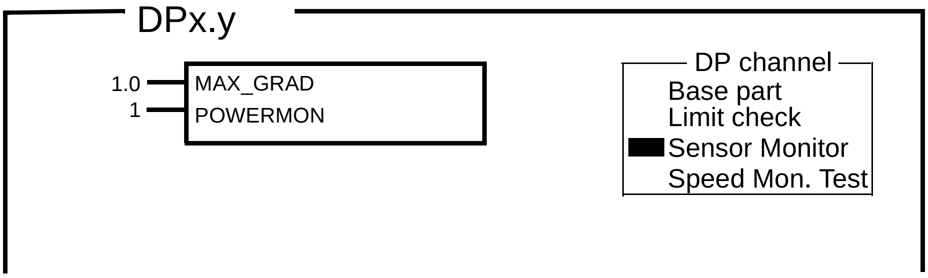


Figure 3-32. Data Base Element DP640, Sensor Monitor

MAX_GRAD <MAXimum GRADient >
This parameter determines at channel 1 the limit for the gradient supervision, measured in percent of nominal speed per second.
Range: 0 to 100 (%/s)
Default: 1.0 (%/s)

POWERMON <POWER MONitor >
This parameter determines if the power supply for the sensor is monitored or not.

Range:	1/0	(on / off)
Default:	1	(on)

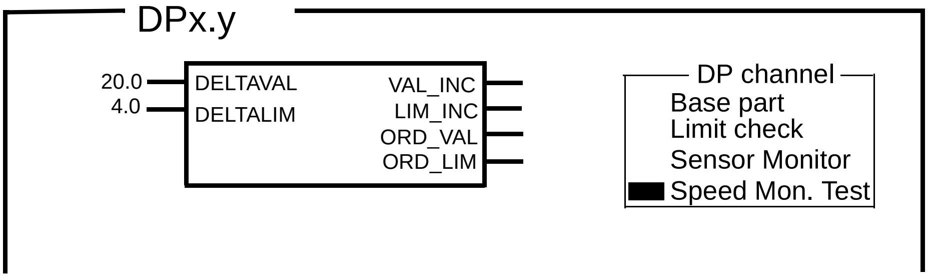


Figure 3-33. Data Base Element DP640, Speed Mon. Test

DELTAVAL <DELTA VALue >
This parameter determines the increment which is added to the measured speed value to test the overspeed mechanism (upon activation of “ORD_VAL”).
Range: 0 to 200 (%)
Default: 20.0 (%)

DELTALIM <DELTA LIMit >
This parameter determines the increment which is added to the overspeed limit (H2 limit) at channel 1 at hot overspeed test (upon activation of “ORD_LIM”).
Range: 0 to 100 (%)
Default: 4.0 (%)

3.6.12 Technical Data

Table 3-23. DP640 Technical Data

Speed Measurement Module	**DP640**
Number of channels	2
Operating modes	• High precision • High speed
Connector type on module	50 pin front connector.
Type of input signals	Line Driver, RS485, 24 V analog, 5V TTL
Electrical characteristics of inputs	
• 24 V_H.I.	-35 to 35 V, Ri = 15 kΩ, f_{max} = 50 kHz
• AC_RET	-35 to 35 V, Ri = 15 kΩ, f_{max} = 50 kHz
• 5 V_TTL	-35 to 35 V, Ri = 3 kΩ, f_{max} = 50 kHz
• 5 V+diff	CMV -15 to 15 V, $Ri,_{ZP}$ =332 Ω,
• 5 V-diff	DIFF.V -6 to 6 V rms, Ri_{diff} =121 Ω
Electrical characteristics of power supply outputs for main speed sensors	All outputs are short circuit and overload proof
• 24 V	24 V ±10%, i_{max} = 50 mA
• -24 V	-24 V ±10%, i_{max} = 50 mA
• 12 V	12 V ±10%, i_{max} = 100 mA
• 5 V	5 V ±10%, i_{max} = 150 mA
Electrical characteristics of buffered output for the main speed signal.	RS422: (differential 5 V line drivers).
Electrical characteristics of transistor trip output (Overspeed signal, TRIPd).	24 V, max. 100 mA, short circuit and overload proof.

Table 3-23. DP640 Technical Data (Continued)

Speed Measurement Module	**DP640**
Electrical characteristics of relay contacts	Mechanical life: min. 3×10^6 cycles Electrical life: min. 3.5×10^5 cycles Isolation: contact to contact: test voltage 1000 V a.c. contact to coil: test voltage 1000 V a.c. breaking capability:24 V 1.1 A d.c. 60 V 0.5 A d.c. 30 V 1.0 A a.c.
Isolation of inputs / power supply (test voltage)	500 V_{rms}, sinus 50 Hz, 1 min.
Transfer Characteristics of measurement	
• Max. input pulse frequency Min. input frequency	50 kHz 0.03 Hz
• Resolution at nominal speed at input frequencies < 10 Hz	 Better than 100 ppm (0.01% steps) Better than 1.25 ppm of actual value
• Accuracy Initial accuracy Temperature drift	 ±50 ppm ±50 ppm/°C (-25 to +75 °C)
• Speed measurement dead time	5 ms (= update cycle)
• Measured period (depending on parameters). At 3000 rpm nom. speed and 100% actual speed with HIGHPREC = 1	20 ms
• Overspeed detection delay (trip signal at transistor, at BIOB, depending on measured period)	max. 10 ms delay (at 3000 rpm, 110% limit)
Power consumption from BIOB 24 V	8 W

3.6.13 Front View

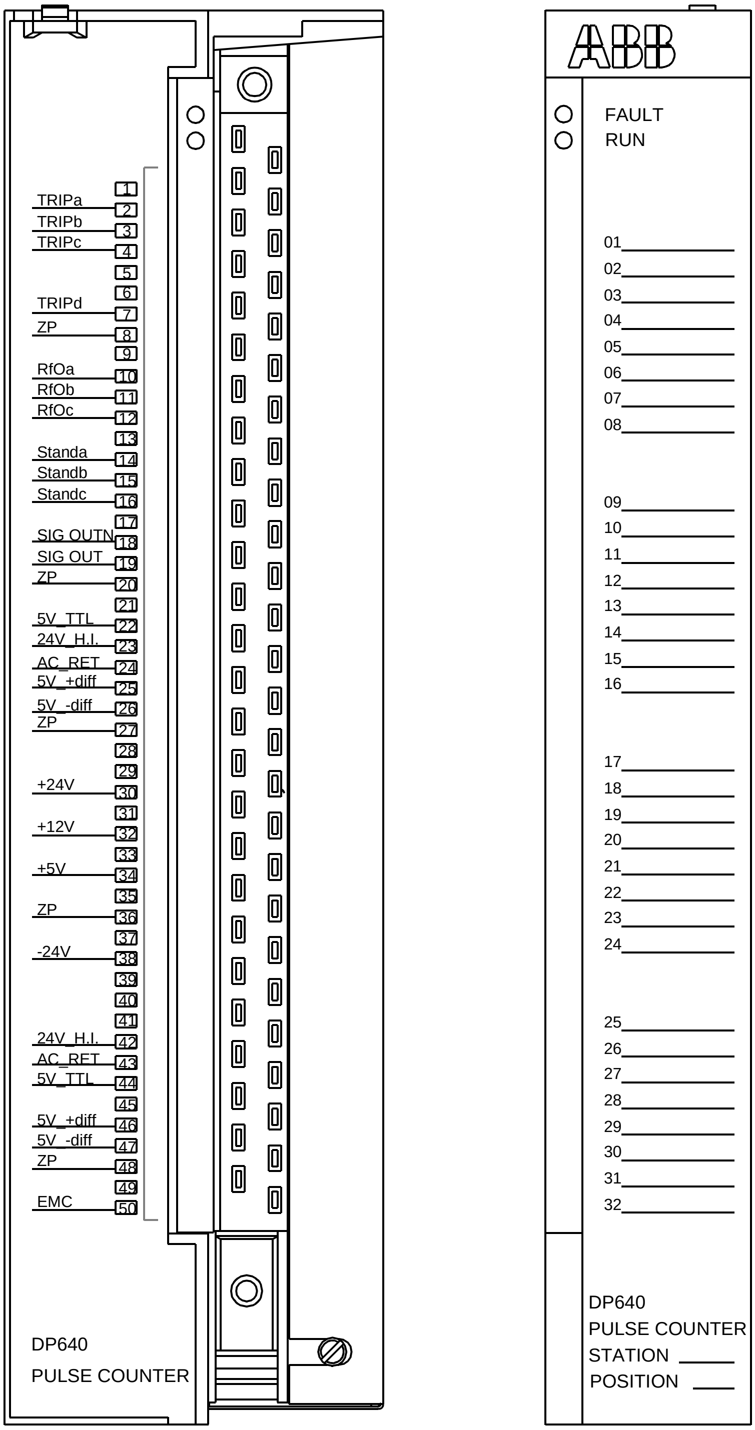


Figure 3-34. Module DP640 with Open Front Door (left) and Front View (right)

3.6.14 Process Connection

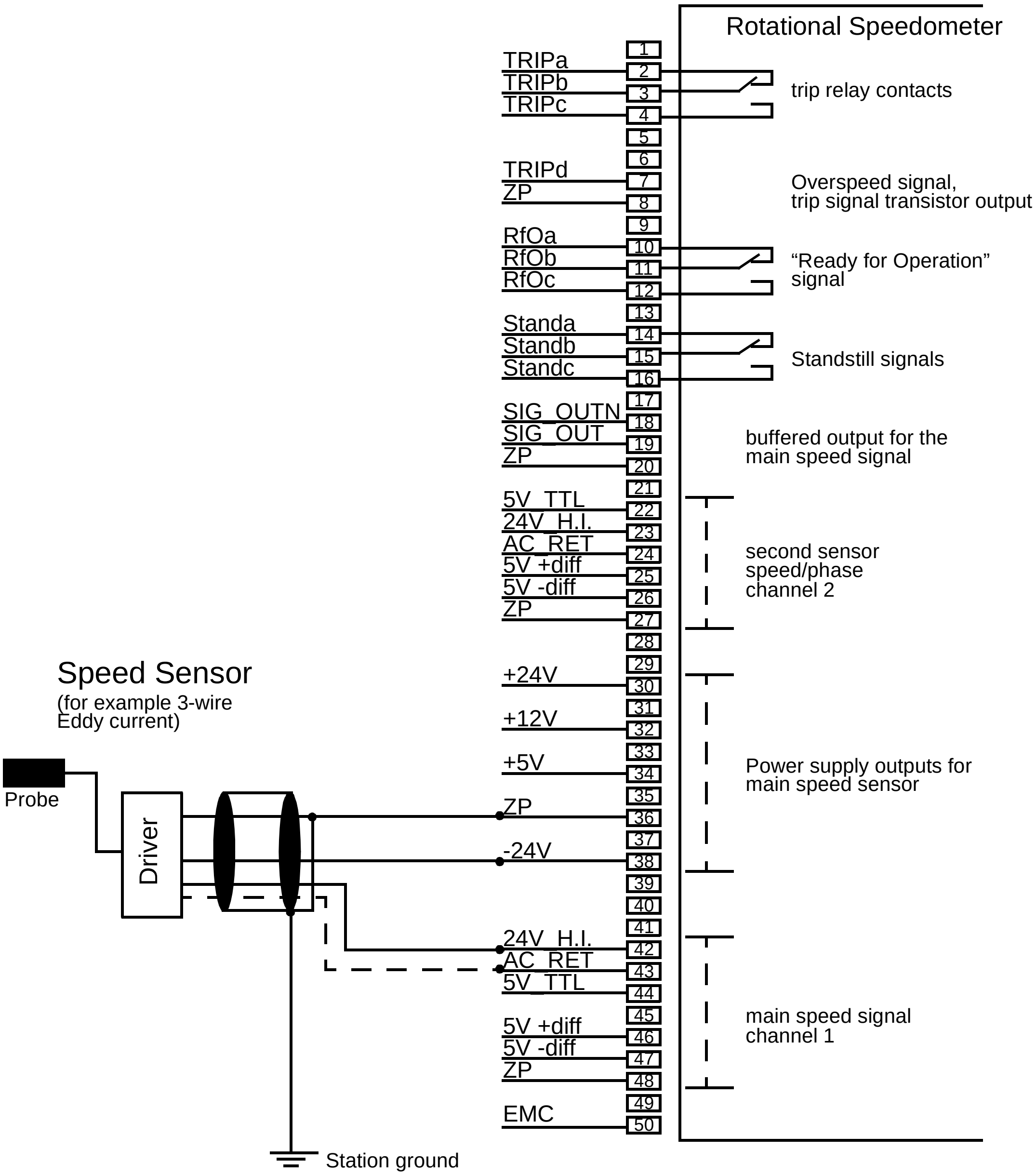


Figure 3-35. DP640 Process Connection

3.7 DX610

3.7.1 Module Description

Summary

The module is mainly used in a Boiler Protection System for activating the triggering actuators of the protection equipment in connection with Processor Module PM646. The digital input / output module DX610 combines the function of digital inputs and relay output interfaces. The digital inputs are used to read back the output channels. The inputs can not be used for standard input operations. There are 6 identical function units. Each function unit contains 3 isolated relay-contacts. The relays of function unit 1 to 6 can be operated by the Controller via BIOB. The position of each relay can be interrogated by an auxiliary contact. This contact is connected to a digital input channel. The relays of function units 1 to 6 can jointly be connected or disconnected via a separate relay (second shut down path). This relay is triggered via a separate wired input by the Processing Module PM646.

A special PC-Element (PC_DX610) is available for Boiler Protection Systems to operate and check the module.

Associated Data Base Elements

Associated data base elements are DX610 for the module and DXIS/DXOS for its input/output channels.

Module Replacement

Online replacement is possible. No jumpering and no adjustments are required.

3.7.2 Technical Data

Table 3-24. DX610 Technical Data

Digital output	DX610
Number of function units	6
Output signal range (relay contacts) • Max. switching voltage • Max. switching current • Max. contact rating • Max. pick-up time • Max. release time • Max. bounce time	 60 V d.c. 2 A quick acting 120 W 30 ms 20 ms 1 ms
Type of output	Relay contacts
Input signal range (coil) • Min. pick-up voltage at 20 °C • Max. release voltage at 20 °C • Coil resistance at 20 °C	 18 V d.c. 3.6 V d.c. 1152 Ω ±10%
Monitoring for UP	6
Max. Cable length	1000 m
Operating modes • Normal digital input • Normal digital output	 Bounce filter (analog), time delay 8 ms Bounce filter (analog), time delay 8 ms
Isolation • Test voltage between output channels • Test voltage between system and output channels	Per input / output channel 560 V_{rms} 1500 V_{rms}
Power supply voltage (redundant USA, USB)	24 V d.c.
Power dissipation of the module • typ. • max.	 4.8 W 6.9 W
Weight	1.1 kg

3.7.3 Front View DX610

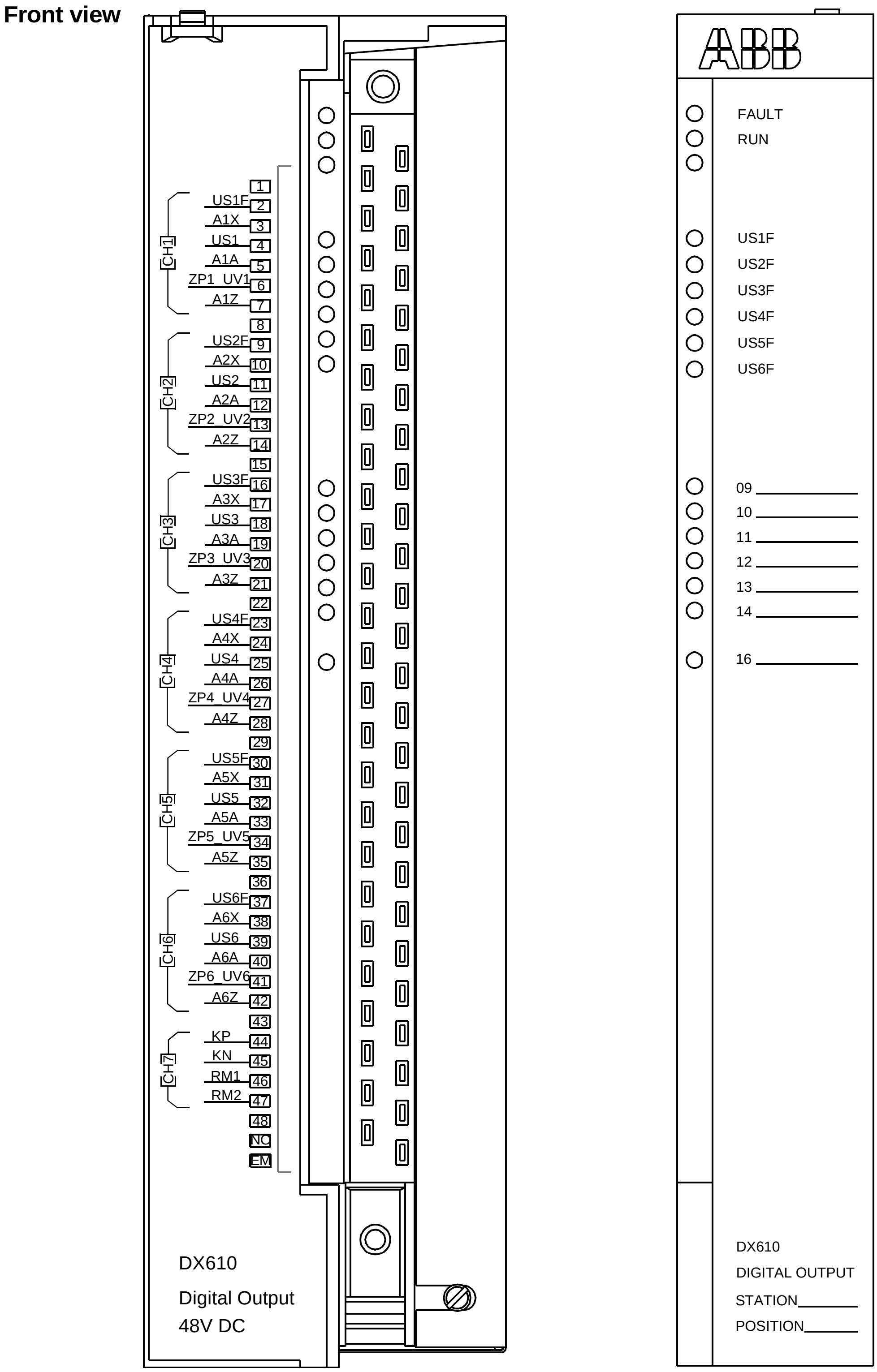


Figure 3-36. DX610 Front View

3.7.4 Process Connections

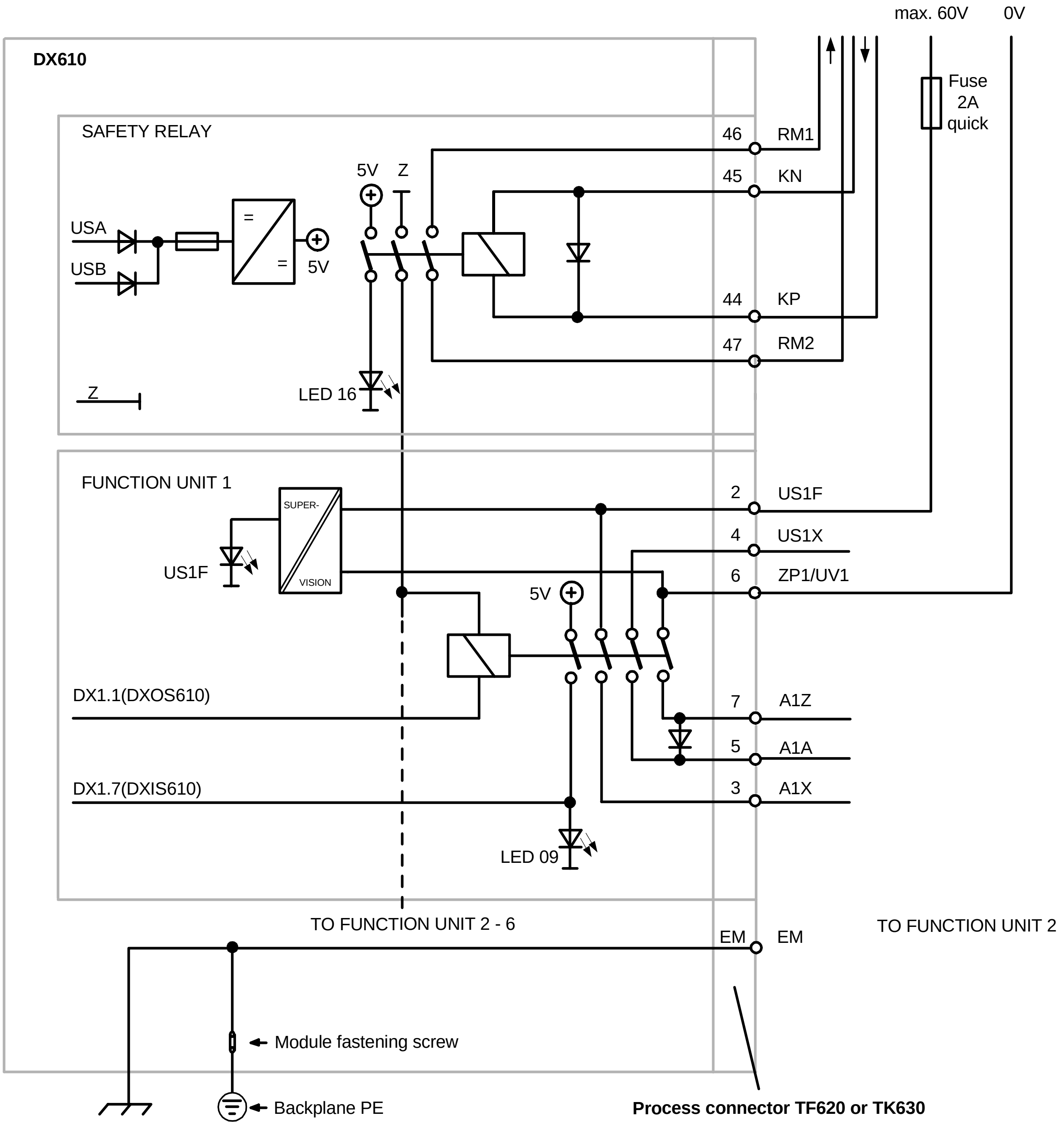


Figure 3-37. DX610 Process Connections Overview

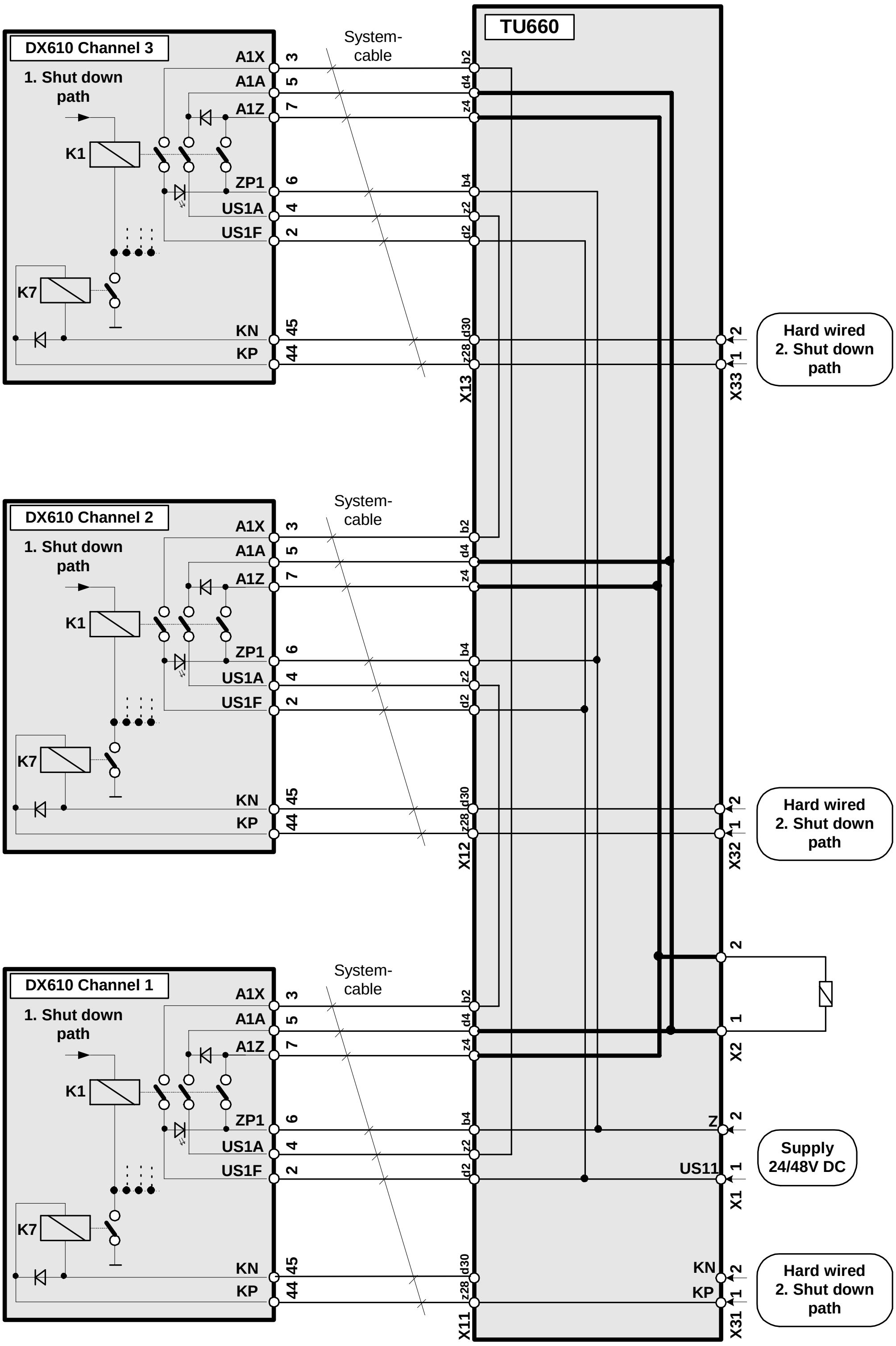


Figure 3-38. DX610 Example Process Connections for Safety Application

3.7.5 Functional Description

The module has 6 identical function units. At each function unit 3 isolated outputs (relay contacts) are available (terminals US*x*F, US*x*X, ZP*x*/UV*x*, A*x*Z, A*x*A, A*x*X, *x* = 1 to 6). This allows to perform disconnecting operations, e.g. 2-out-of-3. The relays are triggered by digital outputs. The outputs are controlled by the Processor Module.

There are 19 LEDs on the front of the module. A green LED (RUN) indicates that the module is operating normally. A red LED (FAULT) signals a severe fault. The status of each individual input is indicated by the first 8 yellow LED´s. The status of each individual output is indicated by the second 8 yellow LEDs.

The outputs for connecting the actuators are protected by a zero diode. In contrast to module 81AR01 the fuses for the supply lines of the actuators are not installed on the module.

Position of each relay in function unit 1 to 6 can be interrogated by an auxiliary contact. This contact is connected to a digital input. The relays of function units 1 to 6 can jointly be connected or disconnected via a separate relay. The module provides two input terminals (KN, KP) to trigger this separate relay and allows to read back the relay state from an auxiliary contact (terminals RM1, RM2).

The supply lines for the actuators are connected to relay contacts of the function units. A monitoring circuit in the digital input/output module monitors the external process voltage UP for each function unit separately. The UP supervision responds if the process voltage is too low, which is indicated by the corresponding data base element.

Input/Output Characteristics

The input circuits and the output circuits are galvanically isolated from the electronic power supply of the backplane,

The I/O channels are also galvanically isolated from each other.

If a severe fault is detected, the LED (FAULT) lights up and all channels are set to „0“.

Filtering

The module provides the same filter functions and operating modes as the input module DI621 and the output module DO620.

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